

Inquiry Learning in an ICT-rich Environment



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Abstract

This mixed method study investigates the use of information and communication technologies to implement inquiry-based learning with primary school students. The ways that teachers and students use ICTs during the inquiry process were examined. Teachers and students were asked their perceptions of the usefulness of the various technologies for implementing inquiry-based learning. This study found that a range of technologies were supportive of inquiry-based learning in a number of ways. Both teachers and students perceived that several technologies they used aided the implementation of inquiry-based learning.

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Introduction

My experiences as a primary teacher who is enthusiastic about implementing inquiry-based learning have led me to believe that information and communication technologies (ICTs) have a unique place in enhancing inquiry approaches and I wanted to explore this further. Working with teachers as part of the Kopu ICTPD cluster and Digital Opportunities projects, I saw a need for teachers to be able to access information on inquiry learning including how, and indeed if, ICT supports that learning.

Inquiry-based learning has been a passion of mine for many years. I like the student-centred nature of the approach where students have more control of their own learning, and the way it is used to help students construct their own understandings on topics. My observation has been that students are more engaged and motivated and appear to gain better understanding of topics studied when using inquiry-based approaches.

Large numbers of clusters and schools in New Zealand have adopted inquiry learning approaches as their pedagogical focus but it is hard for busy teachers to access quality information that is relevant to the New Zealand situation. Much of the information is written in America and the United Kingdom and while some is relevant to New Zealand schools, not all of it is. Very little research is available that explores the use of ICT to support inquiry-based learning in a New Zealand setting.

Literature Review

Inquiry Learning

What is Inquiry?

The Galileo Educational Network Association (2006) define inquiry as “a *systematic investigation or study into a worthy question, issue, problem or idea.*” Inquiry learning is based on a constructivist epistemology where learners construct their own knowledge based on their experiences and interactions with the world around them. Dewey (1938) is generally accepted as the founder of inquiry-based learning although some trace it back to Socrates and his approach of questioning leading to development of self-knowledge (Educational Broadcasting Corporation (EBC), 2004a).

Inquiry takes students out of the pre digested format of the textbook and into the process of learning from a variety of sources to construct their own understandings. They learn to think through subject content apart from prescribed responses or preset solutions. They are guided through a process of intellectual construction that enables them to build on what they already know and come to a deeper understanding of the concepts and problems underlying the subject. (Kuhthlau, 2003, p.6)

Inquiry learning is a student-centred approach to learning where the teacher acts as a guide or facilitator of learning (EBC, 2004b, 2004c). Other features of inquiry are use of authentic contexts (Jakes, Pennington & Knodle, 2002) and student ownership of learning (Alberta Learning, 2004).

Types and Models

There are a large number of inquiry-based models being used in schools. Modern models of inquiry are thought to have evolved from the work of Richard Suchman (EBC, 2004c, Saskatchewan Education, 1991). Some models like that on the Inquiry page <http://inquiry.uiuc.edu/> are science/maths based investigations and are based in the scientific method. Many have evolved from their scientific base to include creative options for students.

Then there are those like the Big 6 (Eisenberg & Berkowitz, 2004), Action Learning (Gawith, 1988), 3 Doors to Infoliteracy® (Gawith, 2000), the Research Cycle (McKenzie, 2000b) and SAUCE (Bond, 2001). These have an information literacy base and have knowledge and

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understanding of concepts among their goals, but also include some form of product and communication or some form of new knowledge production or action (sometimes social action) at the end of the inquiry.

The main difference between these two approaches is how they go about finding the answers, with the first being more likely to involve experiments and positivist, quantitative research and the latter being more qualitative, mainly involving research through reading, observations and interviews etc. hence the reason the latter are often referred to as information literacy models.

There are a number of other inquiry-based models such as problem-based learning, project-based learning, curriculum integration (Beane, 1997) and communities of thinking (Harpaz & Lefstein, 2000). These models were not used by the teachers selected for in-depth study so they have not been further explored.

Although many inquiry models appear on the surface to be linear, this is often not the case in practice with students often returning to earlier stages throughout the process (Owens, Hester & Teale, 2002).

Authenticity

Brown, Collins and Duguid (1989) define authentic activities as “*the ordinary practices of the culture*” (p. 34). They believe that learning and doing are inter-related and should not be separated. If knowledge and its context are separated then the knowledge remains inert, just as you can acquire a tool but not be able to use it. They also believe that where classroom tasks are not authentic, students may come to rely on the features of classroom tasks (school-based cues) that are not present in authentic activities, and will therefore be unable to apply their learning.

The Galileo Learning Network (2005) has produced an Inquiry Rubric (see Appendix Eight) which includes a section on authenticity. Their criteria for authenticity include that the inquiry has meaning to students, is one that adults may actually tackle, and provides opportunities to contribute to the world’s knowledge.

Cronin, (1993) gives the main point of authentic learning as letting students encounter and master situations that resemble real life. He talks about the concept of authenticity being on a continuum and asks that teachers move their activities along the continuum in the direction of fully authentic learning.

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Newmann and Wehlage (1993) use the term authentic to distinguish between work that meaningful and significant and that which is useless and trivial. The audience to whom the results will be presented should be able to use the information. They propose the following criteria for identifying authentic achievement:

- Students use disciplined inquiry
- Students construct meaning and produce knowledge, and
- Students work towards the production of products, performances and discourses that have meaning or value beyond school success.

Wehlage, Newmann and Secada (1996) believe that for learning to be authentic it must “*have an impact on others beyond the simple demonstration that they are competent*” (p. 26). They do however note that although all three criteria (Newmann & Wehlage, 1993) need to be present for authentic learning to occur, some activities will be biased more towards some criteria than others. They discuss the motivating factor of authentic learning believing this may be because the work has personal meaning to students, other than demonstrating competence to their teacher.

The Problem, Task or Question

The heart of inquiry-based learning is the problem, task or question under investigation. Harpaz and Lefstein (2000) in their ‘communities of thinking’ framework, propose a questioning pedagogy as opposed to an answering pedagogy which they believe is dominant in many schools. They give six characteristics of fertile questions, they are: open-ended, undermining, rich, connected, charged and practical.

Jamie McKenzie (1997b) also discusses the types of questions suitable for inquiry which he refers to as essential questions. “*These are questions which touch our hearts and souls. They are central to our lives. They help to define what it means to be human*” (para. 3). McKenzie (2006) distinguishes essential questions from demanding questions “*To merit the label "essential" a question must meet some very rigorous criteria or tests of significance. It must pass the test of "So what?"*” (p.1)

The Galileo Educational Network Association (2004) also talk of essential questions which “*develop foundational understandings. They provide the fundamental organizing principles that bound an inquiry and guide the development of meaningful, authentic tasks*” (para.1).

Edelson, Gordin and Pea (1999) identified some elements of a topic that gave the investigation increased levels of interest and value which resulted in engagement. They included:

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- There were potentially direct implications for students
- The implications of the topic drew on student's sense of fairness and entitlement
- The inquiry was open-ended

Guided Inquiry

How much guidance should we give students when implementing inquiry-based learning?

Mayer (2004) reviewed the research on pure discovery learning and concluded "*a dispassionate review of the relevant research literatures shows that discovery-based practice is not as effective as guided discovery*" (p.18).

Kirschner, Sweller & Clark (2006) consider how student guidance is linked to cognitive load theory (Sweller, 1988). They discuss how this is related to the limitations of working memory as opposed to long-term memory. Two characteristics of working memory are that it is limited in duration and capacity. The result of this is that we cannot deal with too much new information at once. While working memory is used to search for solutions to problems, it cannot be used to learn.

Guided instruction results in more fact recall and transfer of skills (Mayer, 2001 as cited in Kirschner, Sweller & Clark, 2006). The challenge for educators is to present new information in ways that encourage students to be cognitively active while minimizing any factors which "*interfere with students' ability to select, organise, and integrate the new information with prior knowledge*" (Moreno, 2004, p. 109).

Vygotsky (1978) tells us there is a need to scaffold learning, to work with students in the zone of proximal development: "*The distance between the actual development level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers*" (p.86). The challenge is to provide just the right amount of scaffolding, while aiming for as much student independence and ownership of the inquiry as possible.

Herron's four levels of inquiry (1971) provide a model for determining how child-centred and independently achieved an inquiry is. In this model there are four levels of inquiry starting at level 0 where the problem, procedure and solution are all given by the teacher, going through 'structured inquiry' and 'guided Inquiry' to level 3 – 'open inquiry' where the problem is student-formulated, the procedures are student designed and selected, and the solution is not known in advance.

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Bednar, Cunningham, Duffy and Perry (1992) believe that it is important that students learn to construct multiple perspectives. They consider the teacher has a role in enabling students to understand alternative views on issues.

Another area where teachers can provide guidance is in the activation of students' prior knowledge. This has been shown to be effective in connecting new knowledge to old (Hunt & Minstrell, 1994 as cited in Edelson, Gordin & Pea, 1999), enabling students to grasp new knowledge and concepts (Donovan, Bransford & Pellegrino, 1999) and in increasing student interest levels (Edelson, Gordin & Pea, 1999).

Harpaz (2003) constructed a formula for teaching thinking: "good thinking = thinking skills + thinking dispositions + understanding of knowledge" (p. 4). He believes that constructing understanding of knowledge should be the dominant approach, but that dispositions and skills need to be taught within this approach. Within the understanding approach he believes the teacher's role is "to arouse motivation for investigative learning by arousing interest or undermining basic premises and taken-for-granted beliefs" (Harpaz, 2003, p. 15).

Student Ownership of Inquiry

Problems can occur when trying to provide maximum student ownership of inquiry while at the same time recognising that sometimes students, especially young ones, are sometimes unaware of what they need to learn, they don't know what they don't know. One issue is the so-called 'learning paradox' (Bereiter, 1985) which asks a question first put forward by Plato – how can we inquire about something if we don't know it exists? Jacqueline and Martin Brooks (1993) make the following point:

Posing problems of emerging relevance is a guiding principle of constructivist pedagogy. However, relevance does not have to be pre-existing for the student. Not all students arrive at the classroom door interested in learning about verb constructs, motion and mechanics, biological cycles, or historical timelines, but most students can be helped to construct understandings of the importance of these topics. Relevance can emerge through teacher mediation. (p35)

ICT-Rich Environments

ICT-rich Environment for Inquiry-based Learning

When thinking about what constitutes an ICT-rich environment when implementing inquiry learning we need to look first at what constitutes a constructivist classroom environment. Wilson (1995) defines this as:

a place where learners may work together and support each other as they use a variety of tools and information resources in their pursuit of learning goals and problem-solving activities. (p.29)

Taylor (1980) described three different modes of computer use, tutor, tool and tutee. When being used as a tool the computer saves the learner time by completing low level tasks quickly and easily, allowing the learner to focus on higher order tasks: *"When students use computers to find, sort, sift and analyse information then the computer becomes a conduit for knowledge construction rather than a communicator of knowledge"* (Duffy & Jonassen, 1992, p. 10).

So which tools and information sources are needed for inquiry-based learning, which aspects of technology can be useful in a constructivist learning environment? One way ICT is used as an information resource (Wilson, 1995) or as an information bank (Perkins, 1992) is to access to primary sources of information. Examples of primary sources which can be easily accessed using technology are: discussions with experts via e-mail, phone or video conference, online databases and repositories of information such as letters, photographs, diaries, and research reports.

Projects such as the 'CoVis' project (Pea, Edelson & Gomez, 1994) and the 'Kids as Global Scientists' (KAGS) project (Songer, 1996), have used the internet as a communication tool to connect students with people and primary information sources around the world. The findings from the KAGS project, which used internet telecommunications resources to enable students to make weather predictions, were that *"use of real-time resources and firsthand information has the potential to influence the character of student understandings"* (p. 324).

Grabe and Grabe (2001) give five roles of technology in learning:

- as tools to support construction of knowledge
- as information vehicles for exploring knowledge to support learning-by-constructing
- as a context to support learning by doing
- as a social medium to support learning by conversing
- as an intellectual partner to support learning-by-reflecting

Jonassen, Carr and Yueh (1998) argue that computers should be used as 'mindtools' interpreting and organising personal knowledge. They go on to say that 'mindtools' scaffold reasoning about content by requiring students to "*think about what they know in different, meaningful ways*" (p24).

Tsai (2004) takes this a step further when he argues that in addition to use as a cognitive tool for purposes such as knowledge acquisition and construction and as a meta-cognitive tool for purposes such as filtering and reorganising knowledge, computers should be used as an epistemological tool for purposes such as developing explanatory models and shaping philosophy and worldviews.

ICTs Supporting Inquiry

Woolsey and Bellamy (1997) found that "*technology supported the teacher in centering her curriculum on an inquiry process and enabled students to develop their inquiry on the basis of their own observations* (p. 389). They also found that the data projector encouraged student collaboration and group inquiry by facilitating sharing of information.

Multimedia presentations combining narration with either text or graphics have been shown to be more effective than text alone in facilitating retention and transfer of knowledge (Moreno & Mayer, 1999). However cognitive overload can occur if there is input from too many sources at once eg. animation, narration and background music simultaneously being presented (Mayer & Moreno, 2003).

Hopson, Simms and Knezek (2001) found that a technology-enriched environment had a significant effect on students' higher-order thinking skills at the evaluation level of Bloom's taxonomy. This study compared fifth and sixth grade students in traditional classrooms with students in technology-enriched classrooms and used the Ross Test of Higher Cognitive Processing as a tool for measuring students' higher order thinking skills. The teachers in the study reported that the learning was more student-centred in the technology-rich environment. They also noted that the environment facilitated use of cooperative groups and allowed students to focus on knowledge application rather than knowledge acquisition.

Internet

The 1998 Annual American 'Teaching, Learning and Computing Survey' (Ravitz, Wong, & Becker, 1998) found that the highest level of student use of the internet for research came where there was high speed internet access from within the classroom. This is not a problem for most schools in New Zealand. The 'ICT in Schools Report' (2020 Communications Trust, 2005) found that all schools had access to the internet and 78% of primary schools and 93% of

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secondary schools had high speed internet access. The percentage of classrooms with high speed internet was not reported but 80% of computers in primary schools were internet-capable.

Several studies have asked students what they liked about the internet. The multimedia aspects were popular with students (Fidel et al., 1999) but they were often unsure how to use them (Large & Beheshti, 2000).. Students liked the amount of information that was available on the web (Fidel et al, 1999; Watson, 1998) and its topicality (Fidel et al., 1999).

Students expressed a preference for the internet but liked using both the internet and books. Most liked the web because it was faster, and easier than searching in books. It was also more accessible - they didn't have to visit the library. Some students however found it easier to find information in a book. They were frustrated with the net when they couldn't find the exact information they were looking for (Large & Beheshti, 2000).

Many studies have highlighted the difficulties students have locating, sorting and sifting information from the internet and then applying it to the task (Bilal, 2001; Fidel et al., 1999; Wallace, Kupperman, Krajcik, & Soloway, 2000; Watson, 1998). Salomon & Almog (1998) talk about the 'butterfly defect', noting how internet users flitted from one page to another. "*One item just leads to another, and one is invited to wander from one item to another, lured by the visual appeal of the presentation*" (p.13).

A number of studies have found that students often tried to find the exact answer to their question rather than collecting information from which they could deduce an answer. (Bilal, 2001; Fidel et al., 1999; Wallace et al., 2000). Hirsch (1999) believes that students have trouble finding information that is not an exact fit with the question because they are in Piaget's concrete operational stage.

Children who are in this concrete-operational stage seek information that exactly matches their own search terms or the terminology used by the teacher or in the assignment. In other words, they are concrete thinkers and have trouble with anything that is not an exact fit with their understanding of the question. (Hirsch, 1999, p.1279)

Students also had difficulties sorting 'good' web sites from 'bad'. They used inappropriate criteria to evaluate web sites, judging them on appearance rather than on accuracy and currency. They also tended to dismiss sites with large quantities of text (Agosto, 2002).

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Students did not question the reliability and accuracy of sites and needed to be taught to do this (Watson, 1998).

Along with the concern about students' ability to evaluate accuracy and currency of websites go concerns about internet safety. Schools usually approach this problem by filtering the internet, internet safety policies and procedures, teaching students' safe searching strategies or a combination of both (Balfour, 2002). Internet filtering can, however, sometimes filter useful information and some students can see it as a challenge to find ways around filters (Balfour, 2002).

Scaffolding and support have been shown to aid students in their web-searches (McGregor & Lou, 2004; Oliver, 1999 as cited in Hill, Wiley, Nelson & Han 2004 p. 446). Jones (2002 as cited in Kuiper, Volman,. & Terwel, 2005) found that students, when searching on the web, needed a combination of pre-selected sites and opportunities to search freely.

This was found to be especially true in inquiry-based learning. "*Students require ongoing support to develop and refine their search strategies, which is often a critical component of their inquiry activities.*" (Hoffman, Wu, Krajcik, & Soloway, 2003 p. 341) They continued by saying:

Teachers could provide more support to students as they attempt to make sense of information in an environment [the internet] that does not foster the construction of understanding but merely provides information. Teachers should require students occasionally to suspend their on-line activities to have conversations about the information they are encountering... Through participation in these types of conversations, teachers can mediate student learning to enhance or correct in-process constructions of understanding... it is clear that students can benefit from access to on-line resources when extensive support and scaffolding are provided by the teacher. (p. 343)

Computer Ratios

The current ratio of computers to students in New Zealand primary schools is 1:5 and 80% of those are connected to the internet (2020 Communications Trust, 2005). However this included computers used solely for administration and those in computer labs so is not an accurate representation of the number of computers in classrooms.

Becker (2000) found that there needed to be at least five computers in a classroom before teachers became regular users of computers (teachers also needed a constructivist teaching philosophy and a reasonable level of computer skills). This was supported by Norris, Sullivan,

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Poirot & Soloway (2003) who found that the biggest predictor of technology use was the number of computers in the classroom. They found that at least six computers were required to achieve more than sporadic use. Ravitz, Wong and Becker (1998) found that there needed to be at least four internet-capable computers in the classroom to achieve high student use of the internet for research and/or web- posting.

Numerous studies (Cradler, McNabb, Freeman, & Burchett 2002; Dalton, Hannafin & Hooper 1989; Falloon 2004; Hooper, Temiyarkan and Williams, 1993; Inkpen, Booth, Klawe & Uptis, 1995) have shown that students working cooperatively on computers perform significantly better than those working individually. Inkpen et al. (1995) for example, found that children working together on one computer when working on a puzzle-solving game solved significantly more puzzles than those working individually. Bruder (1992) quotes Professor Simon Hooper as saying: *"Providing a computer for each child may, in fact, hold back that child's performance, because they then lose the benefits of working in a small group."*

Collaborative pairs have been found to be the most effective grouping when students work on computers. Garry Falloon (2004) found that collaborative pairs working on computers were the most efficient. Input from members decreased as group size increased. Falloon (2003 as cited in Falloon; 2004) found that students working in stable cooperative pairs had higher task application and showed more collaborative approaches to the task. *"Groups with three or more students generally worked less effectively, with the input of each member of the group diminishing as the group size increased"* (Falloon, 2004 p.34)

Falloon (2004) found that having more than two students per computer resulted in some children not actively involved. He notes that some students actively used this to their advantage:

'Cruising' was a known strategy amongst some larger groups, whereby they organized their labour so that one of the group was able to 'sit out' a session or part of a session while the other members of the group completed the task. (p.34)

Laptops versus Desktops

Much of the research in this area has centred on exploring the effects of students having 24 hour access to laptops (Lowther, Ross & Morrison, 2003; Rockman et al., 2000) and comparisons of 1:1 laptops with classrooms using shared laptop carts or limited numbers of desktop computers (Gulek & Demirtas, 2005; Russell, Bebell & Higgins, 2004; Trimmel & Bachmann, 2004). However, research comparing the benefits and perceptions of laptops versus desktop computers in the classroom, especially for primary-aged students, is harder to find.

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The CHAOS Digital Opportunities project (Stanley, 2005) involves the use of tablet computers by primary-aged students. Year seven and eight students were asked about the advantages and disadvantages of using the tablets. Some of these features, like the ability to write with a stylus directly onto the laptop, apply only to tablets, but many of the other items mentioned apply equally to other laptop computers. Advantages mentioned by students were portability and that they were motivating to use. Disadvantages included having to get them out and set them up, charging batteries, weight and the lack of a separate mouse.

Online Personal Learning Environments

Online Learning Environments (OLEs) refer to the overall group of products which could include a Learning Management System (LMS), Student Management System (SMS) and a Personal Learning Environment (PLE). Learning management systems (LMSs) such as KnowledgeNET, Interact and Moodle are web-based learning environments. They are part of the school's OLE. Overseas they are often referred to as Virtual Learning Environments (VLEs) (Wenmoth, 2006).

There is very little research available on use of LMSs in primary schools and much of that from tertiary and secondary institutions does not apply to use with younger students. Available research has noted benefits for students and teachers. These have included anytime, anywhere access, (Jacobsen and Kremer, 2000), development of higher level learning styles (Gibbs, 1999) and online discussion forums leading to new learning approaches (Gibbs, 1999).

Methodology and Methods

This research used an interpretivist, mixed methodology research design involving two group participant case studies and surveys of students and teachers.

Data Collection Methods

The methods of data collection used were:

- Teacher questionnaires
- Teacher Interviews
- Student questionnaires
- Student journals
- Student work samples
- Student interviews
- Parent questionnaires
- Teacher journal

Teacher questionnaires

Two different questionnaires were used. The first was a general questionnaire to primary school teachers using ICT in any form to facilitate inquiry learning (Appendix One). This questionnaire was designed to identify teachers working in an ICT-rich environment who could take part in the more in depth questionnaire and interview. It was also intended to obtain background information on which inquiry methods teachers were using and what software and hardware they were using to implement it. Additionally this questionnaire looked at definitions of an ICT-rich environment and problems faced by teachers using ICT to implement inquiry-based learning and some solutions they found.

The second questionnaire (Appendix Two) was targeted at selected primary school teachers who were identified in the first questionnaire as having implemented inquiry-based learning in ICT-rich environments in the last 12 months. The aim of this questionnaire was to identify those stages in the inquiry process where teachers and students were using ICTs and where they found ICTs most effective. Components and outcomes of inquiry-based learning and differences between teaching inquiry in ICT-rich and ICT-poor or no-ICT environments were also investigated.

Teacher interviews

Five teachers were interviewed. The interviews were semi-structured. Teachers were given a list of the questions prior to the interview (Appendix Two). Additional questions were asked

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where clarification or expansion of answers was thought necessary. The aim of the interviews was to expand on teachers' answers to the questionnaire and to develop an in-depth understanding of the ways teachers used ICTs to facilitate inquiry-based learning and how ICTs supported that learning.

The five teachers were from four different schools. Two were male and three were female. Their teaching experience ranged from just under four years to over 20 years. The class levels taught covered all areas from year three to year eight. The teachers had been implementing inquiry-based learning in an ICT-rich environment for times ranging from one year to three and a half years. Three had implemented inquiry prior to being in an ICT-rich environment.

Students

Two groups of students were involved in the study. The first comprised two groups of gifted and talented (GATE) students who were involved in a close study of students undertaking an inquiry under the researcher's guidance and the second were the students of three of the interviewed teachers.

A. Case Study Students

Two groups of (GATE) students were involved in this participant case study. The nature of the study is described in the overview section of the case study findings. My role was that of teacher/facilitator of the inquiry undertaken by each group. Data about these two groups was collected using the following instruments:

Questionnaires

The students in the GATE case studies completed three questionnaires (see Appendix Three), the first after they had completed the task selection and planning stage; the second after the data collection stage; and the third when the project was completed. These questionnaires looked at how helpful and useful ICTs had been. The final questionnaire aimed to investigate students' preferences for using either books or the internet and also their preferences for either writing or typing, as well as which ICTs they perceived had been the most useful to them in their inquiry. Students were also asked about any problems they had experienced during the project. Three additional questions related to the KnowledgeNET were asked and answered in the students' online journals.

Journals

The eight students in the two case study groups kept journals on the KnowledgeNET where they recorded their enjoyment and difficulty levels as they worked on the project.

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They were also able to make comments and ask questions relating to the project or their inquiry. Tasks were also recorded, and in some cases completed, in these journals.

Work samples

Samples of student work completed on the KnowledgeNET were examined.

Interviews

The students in the case studies were interviewed twice during the study – mid-way through the data collection stage and when the project was completed. These semi-structured interviews were group interviews with each of the two groups being interviewed separately. At each stage students completed a questionnaire prior to the interview. The interview questions related to their answers to the questionnaire and other comments they had made during the face-to-face sessions so that I could obtain a more in-depth understanding of their thoughts and feelings related to their use of ICT to support their inquiry.

B. Non-case Study Students

Three other groups of students were also given questionnaires. These were students of three of the teachers chosen for in-depth interviews. It was not possible to question students from the other two classes. The students were asked about how helpful they found various ICTs during a recent inquiry unit and about any problems they had encountered. Two classes were also asked about their preferences for laptop or desktop computers (if any) and the reasons for this preference. The purpose of these questionnaires was to see if the findings from the small case study GATE groups were replicated in the larger class groups and to see if the students' perceptions of the usefulness of the ICT items corresponded with those of their teachers.

My Journal

As part of the case studies I kept a journal of the work undertaken by the students and myself. Which ICTs and how they were used was noted. Preparation tasks were also recorded as well as any problems encountered and how they were solved.

Sample

A targeted sampling technique was used. Details of the criteria for selection of students for the case study are included in the 'Selection of Students' section of the case study findings.

Teachers for the first questionnaire were selected on the basis that they were using, or had recently used, some form of ICT to aid implementation of inquiry-based learning. I personally contacted the facilitators of the three ICTPD clusters in my area that I knew had an inquiry focus

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and asked them to distribute questionnaires to any teachers they knew were implementing inquiry learning. I also individually contacted the principals of two large schools and several individual teachers I knew were implementing inquiry-based learning using ICT. I put a message on the CompEd listserv (an ICT-in-education related listserv) asking for participants. I also did an internet search for schools using inquiry-based learning and contacted them via e-mail.

The results were not as successful as I had hoped. The most successful approach was via personal contact with the facilitators or principals. There would have been approximately 100 eligible teachers in the schools/clusters I personally contacted and I received 25 replies. I received two replies via the listserv. The e-mails to schools I found via a web search was not successful. I initially contacted 30 schools this way, intending to approach more if this method was successful. I received only one reply from one teacher so I did not repeat the procedure.

A total of 28 replies were received. Three of these had to be disregarded as the teachers did not meet the criteria. This questionnaire enabled me to identify teachers for in-depth questionnaires and interviews. Eight were approached and five agreed to take part. In addition this questionnaire provided useful background information as described in the methods section.

It would appear from the replies I received that those answering were not a representative sample of teachers using ICT to implement inquiry-based learning, but rather they mainly self-selected on the basis that they were working in ICT-rich environments. 21 of the 28 respondents considered that they were working in an ICT-rich environment and the data they supplied on the ICT in their classrooms seems to support their belief. The average ratio of students to internet-capable computers in the classroom was 1:4.1 and if computers outside the classroom (eg. in computer labs) but readily available were included, then the ratio was 1:2.

Students, other than those in the case study group, were selected on the basis that their teachers were selected for in-depth interviews. Only three classes were given questionnaires. The other classes were unable to take part within the timeframe of the research. Two of the classes were from one school. Students were free to choose whether they wished to complete the questionnaire. Two children in the selected classes opted not to take part.

Informed Consent

Informed consent was obtained from all participants. In most cases this took the form of a letter explaining the study and participants' rights, with contact details for further information if required and a written consent form. The five teachers selected for in-depth interviews were contacted individually and the research was discussed with them.

Letters were sent to all case study participants including pupils, parents, teachers and the board of trustees of the school where the case studies would take place. A parent meeting was held to inform the parents of students involved in the case study. Details of the nature and scope of the project and related matters were presented and a question and answer session was held. A meeting of pupils in the case study was held to explain the project to them. Written consent was sought and obtained from parents and written assent was given by pupils. All participants were informed that they were able to withdraw at any time.

Analysis of data

Thematic analysis was used to examine the data from interviews and the answers to open-ended questions in the questionnaires. This data was then coded where themes and patterns emerged. A mainly grounded theory approach was used with categories arising from the data.

Research Questions

- ◆ How do primary school teachers use ICTs to support their students' learning when involved in the inquiry process and what are their perceptions of this use?
 - What are the teachers' definitions of the inquiry process?
 - In what ways and to what extent do the teachers feel ICTs support the inquiry process?
 - In what ways do the teachers use ICTs to support the inquiry process?
- ◆ How do primary school students use ICTs to support their learning when involved in the inquiry process and what are their perceptions of this use?
 - What ways do the students use ICT's to support the inquiry process?
 - How do the students feel ICTs support the inquiry process?

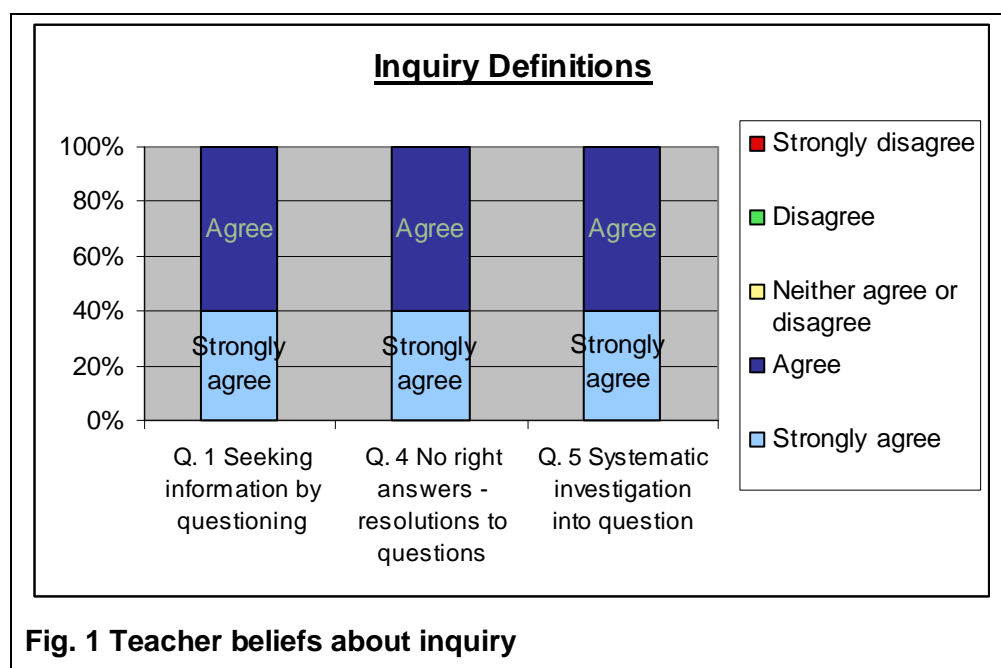
Findings

Inquiry Learning

All data in this section was gained from the questionnaires and interviews of the five teachers selected for in-depth study.

Teacher Definitions of Inquiry

The teachers were asked about their beliefs relating to inquiry learning. They were given a number of statements about inquiry then asked how these statements fitted with their own beliefs. Three statements are simple definitions of inquiry (see Fig. 1) Teachers all agreed or strongly agreed with these statements (See Appendix Two) which related to inquiry being an investigation into questions, issues, problems or ideas. The teachers were asked to give their own definitions of inquiry and all mentioned students finding answers to questions or investigations.



Two statements in the questionnaire related to the role of the teacher and students (see Appendix Two). All teachers agreed with the statement that the teacher's role was that of a colleague or mentor on the same quest as the learner (see Fig. 2), but none strongly agreed. Two teachers commented that students weren't always ready to take full control of their learning and one commented that it was a challenge for teachers to let go control. All felt there was a need to guide the learning of primary-aged students when working on an inquiry.

All teachers agreed that inquiries should be based on students' own questions and one teacher strongly agreed with this statement. Three of the teachers mentioned the student-centred nature of inquiry in their own definitions. One of the teachers felt that the inquiry could be either teacher or student-initiated. Two teachers commented that they believed students did not always have the necessary skills to devise suitable questions for inquiry independently and needed guidance to do this.

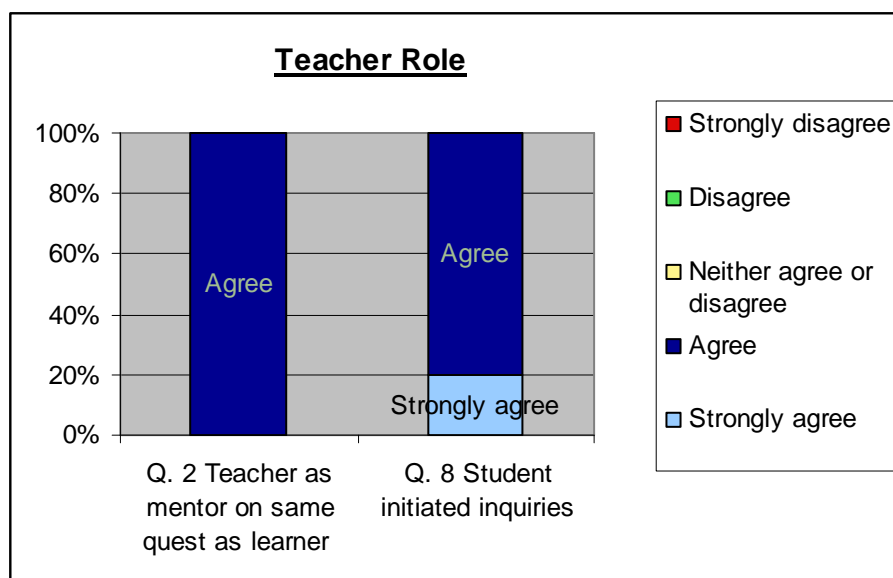


Fig. 2 Teacher beliefs about teacher's role in inquiry

Three statements related to the educative purpose of inquiry-based learning (see Appendix Two). The teachers all agreed or strongly agreed that inquiry developed skills for lifelong learning, emphasised development of thinking skills and involved authentic investigations (see Fig. 3). Four of the five teachers strongly agreed that skills for lifelong learning were an emphasis of inquiry-based learning.

The last statement (see statement 9 Appendix Two) related to the results of inquiry and whether there should be action and/or social action as a result of the inquiry. This statement had the greatest range of responses (see Fig. 3) and caused the most comment from the teachers. One teacher chose to both agree and disagree with the last statement commenting: "*As long as it is authentic - not always possible.*"

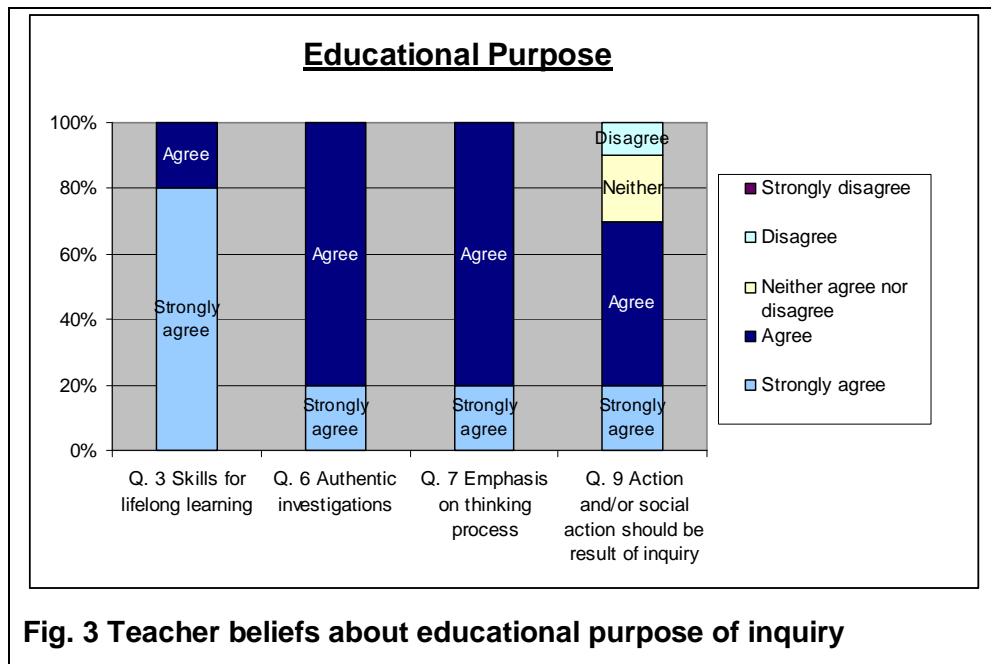
All of the teachers believed there should be some outcome to the inquiry but were divided about the nature of that outcome. All agreed that an action of social significance was not an essential element of inquiry.

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I feel inquiry units don't have to result in a social action - but should always have some sort of outcome. I feel it is fine sometimes just to share results. Sometimes we just want answers without a social action.

One teacher felt that the type of action was related to the age of the students:

[Action is] vital – however sometimes social action is a little less transparent and very much depends on the age of the students.



Types and Models

The five teachers interviewed had looked at a number of inquiry models before most adopted their own school models. Eisenberg and Berkowitz's (2004) 'Big 6™', Jamie McKenzie's (2000b) 'Research Cycle', Gwen Gawith's (1988) 'Action Learning', and Trevor Bond's (2001) 'SAUCE' were the main models explored and/or used by these teachers (see Table 1). Other models explored or used by these teachers were Slam Dunks (McKenzie, 2002) and Base 6 (Bartlett, 2005).

Table 1 Models teachers had heard of and/or used.		
Model	Heard of	Used
Big 6™	80%	20%
Research Cycle	80%	20%
Action Learning	100%	60%
SAUCE	100%	60%
Own school model	80%	80%
Base 6	20%	0%
Slam Dunk	60%	20%

At the time of the study four of the five teachers were using their own school models for inquiry-based learning. The fifth teacher was using a modified version of the SAUCE (Bond, 2001) and Action Learning models (Gawith, 1988). The models were structurally very different, some appearing linear, others circular in nature, but were all very similar in practice. The models were examined and the following elements (though not necessarily in this order) were common to all the models):

- ◆ Motivation/immersion/knowledge bomb stage
- ◆ Inquiries based around a question/problem/task
- ◆ Prior knowledge activated
- ◆ Planning stage
- ◆ Students find and gather information
- ◆ Students sort, sift and analyse information
- ◆ Students construct understanding and apply their new understanding to the problem/task/question
- ◆ Synthesise/create stage
- ◆ Students communicate their findings and/or take action
- ◆ Evaluation of the product and process
- ◆ Reflection and review are ongoing throughout process

These teachers made it clear that the process was not a linear one and students often move backwards and forwards during the process as a result of the ongoing reflection and review process.

Scaffolding and Guided Inquiry

The teachers I interviewed all mentioned that there was a need to scaffold (Vygotsky, 1978) or guide the inquiry process with primary aged students, especially those new to inquiry learning.

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They saw the teacher's role in inquiry as a facilitator, the 'guide on the side' rather than the 'sage on the stage.'

I liken it to travelling the journey on the bus together with me, (teacher) being the bus driver. My passengers can direct where we go but, ultimately, I'm the one responsible and sometimes I need to veer the bus back on track. (Teacher 3)

Teachers also mentioned that often students had more skills than the teacher when it came to use of ICT during inquiry:

You've got to be open to the fact they could quite possibly know more than you about it. They've had more time to play with it than you, so you've got to be able to let go of that "I'm the boss attitude" and just guide them, be more of a guide than standing up the front lecturing. (Teacher 2)

This need for guidance was considered especially important when it came to students using the internet.

We as teachers, that's one of our biggest responsibilities when the students have internet access, you've got to guide them, you've got to go in there and have a look at the sites that mainly you're going to be using. I liken it to taking the kids down to Te Papa and saying "Okay guys go for it." They might know what they're looking for, but do you want them to meander their whole day looking for the information, or do you want to point them in the right direction? (Teacher 3)

Inquiry in ICT-rich Environments

The following findings were obtained via questionnaires and interviews (see Appendix One and Two) of the five selected teachers. Data relating to students was collected via a questionnaire (see Appendix Three).

The five teachers selected for interview all considered they were working in an ICT-rich environment. The ratio of students to internet-capable computers in their classrooms ranged from 1:1 to 1:4.8. They also had between 10 and 13 computers outside the classroom that the teachers considered were readily available. The computers were a mix of laptops and desktops.

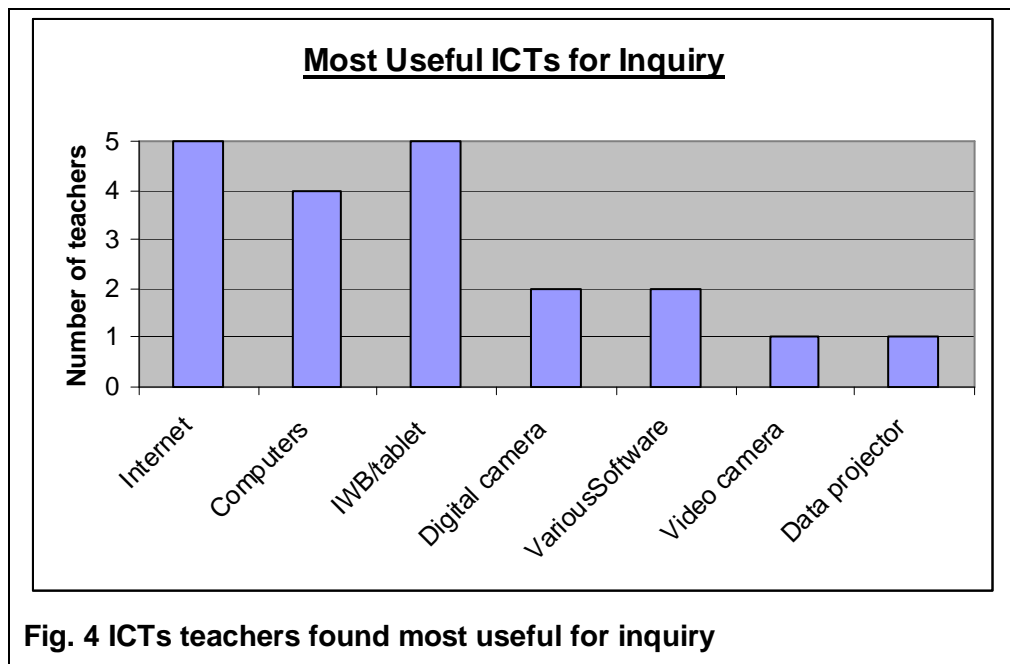
All the classrooms were networked and had Broadband™ internet. Four of the teachers were using some form of internet filtering, the fifth has since begun using filtering. The teachers all had access to the Microsoft™ software packages provided by the Ministry of Education including Microsoft Office™ and a range of other software. Four of the teachers used an LMS (three used KnowledgeNET and one used Moodle).

All teachers had data projectors permanently in their classrooms, four of which were permanently ceiling-mounted. Four of the five teachers had interactive whiteboards (three ACTIVboards and an InterWrite™ board) and remote tablets and the fifth had a Schoolpad™ remote tablet. All teachers had ready access to digital cameras and printers.

The teachers had been implementing inquiry-based learning in an ICT-rich environment for times ranging from one year to three and a half years. Three had implemented inquiry prior to being in an ICT-rich environment.

Useful Technologies

The five teachers interviewed were asked which ICTs they found most useful when implementing inquiry-based learning (see Fig. 4). The internet, computers and interactive whiteboards were considered by far the most useful. Only one teacher specifically mentioned the data projector but these were needed to operate the interactive whiteboards and many features teachers liked about IWBs also applied to data projectors.



The Internet

The internet was high on the list for all the teachers. The main reasons they gave for this choice were up-to date information, interactivity, the scope and availability of information, the ability to go to primary sources of information, immediacy and connectivity with the world outside the classroom.

It just opens up the world to the children, it's just an amazingly rich resource if it's managed properly...It's up-to-date. It's just a rich resource that we're unable to get through books because of our isolation. A lot of the sites are interactive so it helps with the engagement process as well. For example, if you're learning about volcanoes you can make one blow up in your class now. (Teacher 1)

It's up-to-date, such as space ... some of the information hasn't been published, not in books for children. That's demonstrated very well with space, there's always new stuff coming in so it's up-to-date and you're reaching a wider variety of opinions, sources of information. (Teacher 2)

Internet ready computers - gotta have them, absolute must ... The scope of information that's available... It's really good for authenticating sources... Generally there's a webmaster that the children can inquire of, often the actual authors will leave their addresses. Probably 90% of the time when the kids are asking for further information, they get it from their source... it can bring the world into the class, literally. (Teacher 3)

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I think it's the immediacy of the information... If a child comes across something they want to know more about there's more likelihood of getting an immediate response back... They can actually go and find out about it, so it's immediate. (Teacher 4)

The resources you can get off the internet. Resources for the children's research but also getting in touch with other people and the speed of having replies... we've done MSN with other parts of the world and they can ask questions and we do it through MSN ... and it's very interactive and I feel that's very valuable for the children. And the speed using the internet and e-mailing. (Teacher 5)

Computer ratios

I asked the teachers what their preferred student to computer ratio and all opted for either a 1:1 or 1:2 ratio when implementing inquiry learning. Most mentioned the benefits of children working in small groups even if they had 1:1 computers.

One to any more than two, I really find that there is one little poppet who often is ending up missing out. They might be given an important job to do like watching the time; we can do all sorts of things. But the truth of the matter is... any more than two and you've got bystanders. (Teacher 3)

... there's the social aspect and buddying as well. I think they probably work better in pairs than they would on their own. Some children would have difficulty working on their own on a computer, whereas with a buddy or someone to talk to about their information they would get further. (Teacher 2)

One teacher in the study, who currently works in a digital classroom with a ratio of one desktop computer per child, reflected on what the ideal ratio would be, and had this to say:

Ratio: 1:2...I have been observing the class and seeing how often we actually use 1:1. It is not that often...maybe for a writing task or when they are blogging but that doesn't need to be done all together, it can be spread. I think my desire would be a traditional classroom with desks etc. and wireless laptops, which can be utilised when needed and put away when not needed. (Teacher 5)

Laptops versus Desktops

Three of the five teachers were using wireless laptops as well as desktops in their classrooms. Their students had been using both types of computer for times ranging between 12 and 18 months. When the teachers were asked whether they preferred laptops or desktops for student

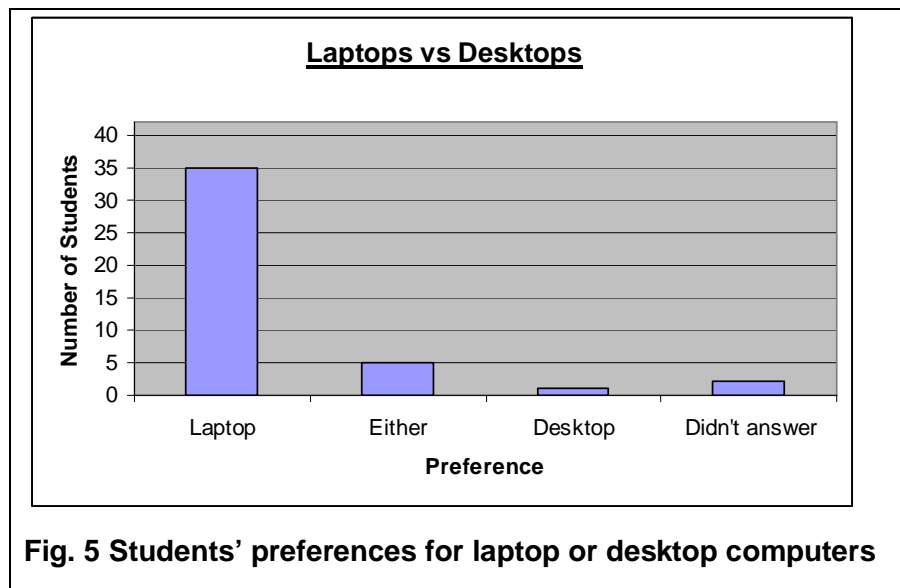
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use, they all said they preferred the laptops. The reasons they gave were portability – the ability for students to work anywhere, that they were used as a resource and that they took up less space.

Just the very nature of desktops they're where the plugs are at the side and it's easier for the kids to interact [with laptops], they can set them up outside, inside and they can work collaboratively. I think it promotes the idea that it's just a resource, just like an atlas would be and they can quickly grab it and they're still engaged in classroom activities. (Teacher 1)

Having it on wireless too is great for the portability of things. They don't have to sit at their desks, they can sit on the mat or wherever ... Having that flexibility. They don't take up as much room as PCs, you don't need extra furniture and things like that. (Teacher 4)

Students in two of these classes (43 students) were asked their preference. They had been using laptops for over a year so novelty value was unlikely to be a factor in their choices. By far the majority of students chose laptops (see Fig. 5).



The reasons given by the students are listed in Table 2. Portability, or the ability to move them anywhere was by far the most common reason given.

"They are easy to move around and you can take it to your seat so you weren't as crowded"

Inquiry Learning in an ICT-rich Environment

"I like the laptops because more people can use them at the same time. I also like them for the wireless connection and a battery, so you can use them outside and in other places without power plugs."

"I like laptops because they are easier to move around and I think they're cooler."

"Because you can take them where you want to. You can take them to your place and work on them. They're light. And easy to use. You don't have to use a mouse that you might have to carry around."

Table 2: Student reasons for laptop/desktop preference	
Reasons for preference	Number of responses
Positives for laptops	
Portable/Move to seat or table/Take to teacher/No plugs, wires etc/Use anywhere	33
Cool/exciting/fun	2
Easier to use	7
Take less room/small	5
More people can use/less crowded	4
Don't need separate mouse	2
Both/Either	
They perform the same	1
Positives for Desktops	
They don't need recharging/no battery issues	2
They don't move as much.	1
Higher performance	1
Have a separate mouse	1

Online Learning Management Systems

Four the teachers interviewed used some form of online learning management system. Three used KnowledgeNET and one used Moodle. Three of the four teachers rated their LMS as very useful for inquiry and used it daily. The fourth teacher rated it as slightly useful for inquiry and used it one or two times per week. This teacher rated the LMS as very useful for students to access websites via weblinks and retrieve information.

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The main uses teachers mentioned were home-school communication, putting on links to relevant sites, posting resources including weblinks, using online discussion forums, making homework available and publishing student work. Students being able to access their schoolwork from home and parents being able to view student work were mentioned as benefits. The resources built into the KnowledgeNET such as the access to online newspapers, learning objects and encyclopedias was also seen as a plus.

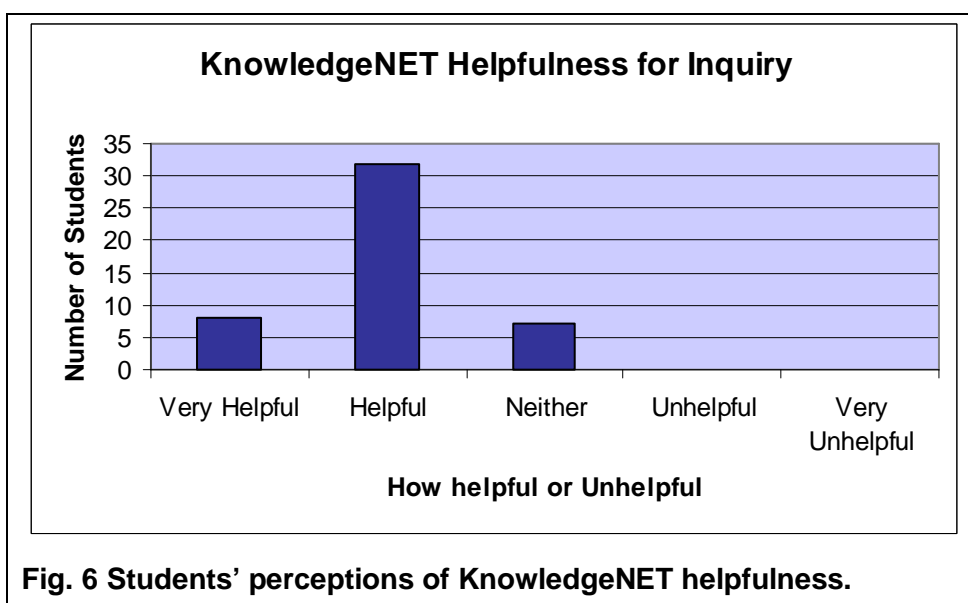
"I've put up links on the KnowledgeNET so they can use those at home, so their parents actually know what they are doing and their parents can get involved in their learning as well." (Teacher 4)

One issue was having sufficient computers to allow students to use the LMS efficiently, especially if students were publishing work there. Teachers overcame this by using computers in computer suites or borrowing computers from other classes when they need to have large numbers of students accessing the LMS at the same time.

Access from home for those students without internet access or when students had computer problems at home was an issue for some. Use of online discussion forums was also limited by student access to the internet at home. Teachers worked around this by allowing their students time in class or after school to use the computers to access their pages or by providing paper copies of the information.

Limiting the amount of work students had to publish on the LMS was another strategy used to overcome this problem. Only one teacher was implementing a programme where virtually all the student work, including homework tasks was completed on computer with the help of an LMS. This teacher not only had an excellent student to computer ratio in their classroom, but students having an internet connection at home was a pre-requisite for inclusion in the class. The other three teachers with an LMS were only having students complete small amounts of written work on the LMS because of access difficulties. These teachers were however making tasks, weblinks, forums and resources available to students at home via the LMS.

The students from the three classes using the KnowledgeNET were asked about how helpful they found the KnowledgeNET during their inquiry. The results are shown in Fig. 6. It was not possible to question the students using Moodle.



Students did not comment on any problems they encountered while using KnowledgeNET. Reasons students gave for finding the KnowledgeNET helpful were:

- Links to helpful websites
- Gave information
- They learnt something using it
- It was quicker and/or easier to find information
- The forums were useful
- Having work accessible at home

Interactive Whiteboards and Data Projectors

The teachers using interactive whiteboards were very enthusiastic about them. The boards were used by both teachers and students during all stages of the inquiry. The teachers listed a number of features that were useful for inquiry-based learning. Some benefits related specifically to interactive whiteboards. The ability for teachers or students to write or type on the board, save the results, then refer back to them later was seen as very useful, as was the ability to manipulate information using the board. The software that came with the boards was also seen as a very useful resource.

Other benefits mentioned could be achieved with a data projector. These include the large screen size so that everyone could see at once and the ability for teachers and students to share internet sites, programs, video or presentations and to model or demonstrate.

It's great for reviewing what you've done the day before or the week before and keeping the children focused on where we started and where we're going to. The

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ability to move things, information, the pictures and for children to actually interact with it. Teacher 2

[Most useful for inquiry are] technologies that allow for interactivity. Specifically for me I'm talking about the interactive whiteboard. That would certainly be my most valuable tool I have had available ... The students use of the interactive whiteboard was vast and often requested ... There's a special connection you can see with a child going up to the whiteboard with the pen and whatever they are needing to do, to actually interact with it. They can change things right there and then, in real time. (Teacher 3)

It's just so great the ACTIVboard™. I wouldn't be without it. It's probably the best ICT thing I've got ... The children can get up and be the teacher, be the guide. It's the interactiveness of it. It's so easy to use by the children too. (Teacher 4)

All teachers had remote slates or tablets. The benefits of these were that the teachers didn't always have to be up the front of the class but could still interact with the computer and that the slate could easily be passed around the class for students to use.

Of the 53 students who answered questions about the board, 20 found it very helpful and 27 found it helpful during their inquiry. For the students the most commonly mentioned features of the boards that they found helpful were the ability to share information and presentations such as their Powerpoint™ slideshows with the class and that there was a big screen so everyone could see at once. Both these could be achieved with a data projector alone. Some students mentioned that they liked being able to write on the board themselves and did not like it if they didn't get a turn to use it. Technical issues were mentioned by some students as being a problem, especially if the pen didn't work when they tried to write.

Digital and Video Cameras

The teachers all found digital and video cameras useful for inquiry. These were used during the information retrieval and product creation stages mainly by the students rather than the teachers. Large numbers of students also mentioned that they found the digital cameras helpful.

Snapshots in time. Effective systematic documentation of the learning and the learning experiences. The kids became empowered with the use of them. (Teacher 3)

Other Useful Hardware

Other items of hardware mentioned by teachers and students as useful were scanners, phones, fax machines, printers, photocopiers, DVD players, video players and pen drives.

Software

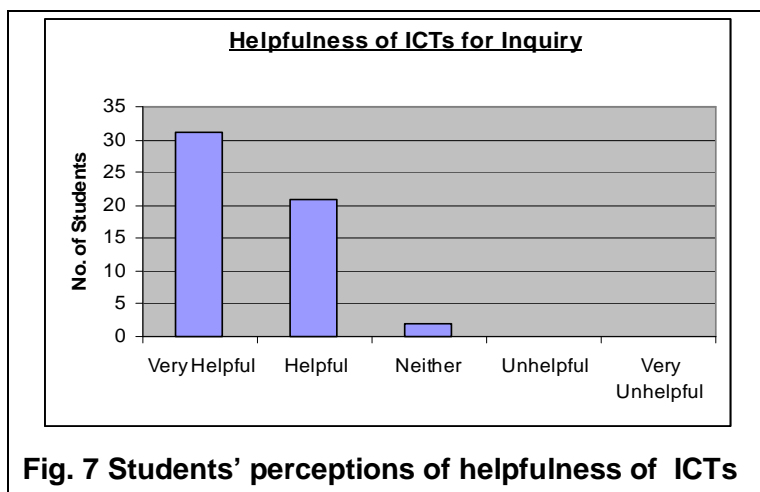
Several items of software were mentioned as very useful. These included Microsoft Word™, Excel™ and PowerPoint™. Word™ was used throughout inquiries, Excel was used mainly at the 'sorting, sifting and analysing information' stage and Powerpoint was used mainly at the 'create and communicate' stage. Photostory™, Moviemaker™, ArtRage™ and Paint™ were other programs found to be useful, especially at the 'create and communicate' stage of inquiries.

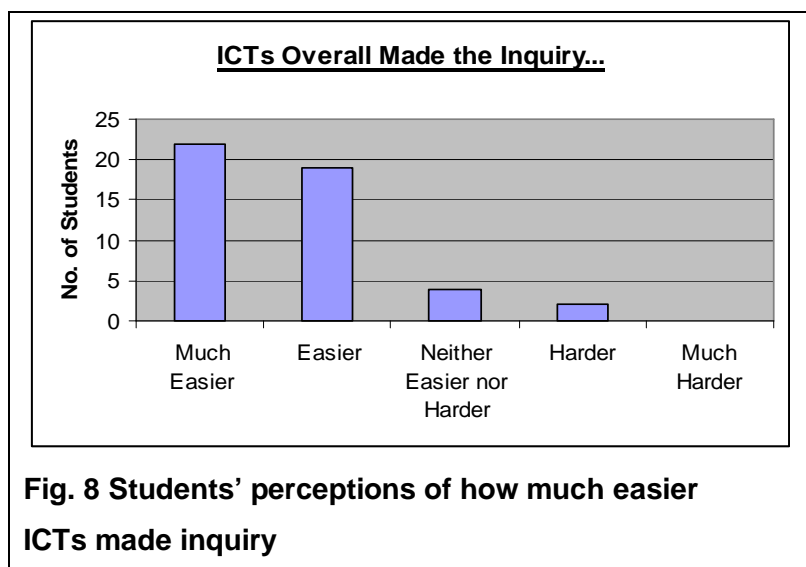
The mind-mapping software Inspiration™ was also considered useful by those teachers who had it. This was mainly used for brainstorming, but some teachers (and their students) used it throughout their inquiries.

It's just a great way of having a big question at the top and breaking it up into subsidiary questions in a nice flow diagram. It really makes it easy to visualise the actual process the kids are going through and for them to visualise what's happening. Then they can reference their answer from the research to answer each question, all on the one page. (Teacher 1)

Overall

Students in the three classes were asked to rate how much easier or harder ICTs had made their last inquiry unit and to rate the helpfulness of the ICTs overall (see Figs. 7 and 8). The majority of students found the ICTs helpful or very helpful for inquiry and thought ICTs made their inquiries easier or much easier.





Problems

The teachers were asked what they liked least about using ICT when implementing inquiry-based learning and all listed technical problems as the number one issue. Some mentioned that technicians were not always quickly available which could cause frustrations. The internet being unavailable was frequently mentioned as an issue, not because it happened a lot but because it was very disruptive when it did.

When you're in an enriched environment where technology is used on a daily basis and at a pivotal moment when that technology lets you down, it certainly leads to frustrations. (Teacher 3)

One teacher mentioned that technical issues had caused a lot of problems initially but felt this had improved with her own skills level:

I've moved along with it so I've been able to sort more problems out, whereas at the start something would happen it would be like a panic situation, whereas now I can deal with most things. And also I think you come up with strategies so that it's not as important, whereas at the start you... probably don't have as many back-up plans or as many ways of doing things without the ICT. (Teacher 2)

Other ICT-related issues teachers mentioned were:

- low ICT skills levels of some students, especially at the start of the year and when students arrived from other schools
- parents concerns, especially with regard to whether the 'basics' were being neglected in digital classrooms

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- lack of student access to computers at home
- making students aware of copyright and plagiarism issues
- making students aware of the need to check the veracity of information sources
- the need to avoid assuming that because students were technologically savvy that they were also able to use ICTs judiciously
- internet safety
- information overload – problems caused by the large amount of information on the internet

The first issue was dealt with by teachers using a mixture of 'just in time and just in case' teaching of skills, with an emphasis on the former. Parent concerns were addressed by keeping parents informed about what the class was doing and the reasons behind what was happening in the classroom. Lack of student access to computers at home was countered by providing access to computers at school, restricting work which students had to complete on the LMS and providing non-ICT copies of resources eg. paper copies.

The issues related to copyright, veracity of information sources and using ICTs wisely were addressed by discussing these issues with the students and teaching them the skills they needed. Internet filtering and teaching internet safety were the measures taken to ensure safe searching for students. Information overload was countered by guided use of the web and use of teacher selected sites and weblinks.

Case Study - An Example of Inquiry-based Learning in and ICT-rich Environment

Overview

This participant case study was a pilot programme which aimed to use an online learning management system (Knowledge Networks™ system referred to from here on as the KnowledgeNET) to support two groups of GATE students completing investigative inquiries (inquiry-based learning). A number of other ICTs, including a Promethean ACTIVboard™ interactive whiteboard and wireless laptops (PCs) with Schoolzone fast internet and internet filtering, were used by the teacher (myself) and students to support learning where appropriate. The usefulness of these ICTs to the students was assessed during the project. Parent feedback was also sought at the end of the project.

Students were withdrawn from class two - three times per week for 30 - 40 minutes, at times convenient to the classroom teachers. Students worked on their investigative inquiries at home as well as at school, using KnowledgeNET as the link. It was hoped KnowledgeNET would allow parents to support their children by logging on at home to view their children's progress on their tasks.

Selection of Students

There were two groups of four students, each group from a different classroom. One group consisted of year 6 & 7 students (Group One) and the other year 7 & 8 students (Group Two). Students were selected after discussions with their classroom teacher. Five of the students selected met the definition of giftedness mentioned in the Riley, Bevan-Brown, Bicknell, Carroll-Lind & Kearney's (2004) report to the Ministry of Education that gifted and talented students "*demonstrate exceptionality in relation to their peers of the same age, culture, or circumstances.*" (p.12). This was based on a multi-method approach to identification using standardised test results, observations by teachers, parents and others and standardised evaluations of portfolios and performance (Riley et al., 2004).

All students met Renzulli's (1998) 'Three Ring Concept of Giftedness' criteria where students demonstrate above average ability plus high levels of creativity and task commitment. Renzulli further defines above average ability thus: "*I clearly have in mind persons who are capable of performance or the potential for performance that is representative of the top 15-20% of any given area of human endeavour.*" Riley et al. (2004) include a definition of gifted and talented students that includes "*The recognition of both performance and potential, or promise and fulfilment*" (p. 11).

Parent Meeting

Prior to starting work with the students I held a parent meeting. This had two main purposes. The first was to ensure that the parents were fully informed as to the nature and scope of the research project. It also gave them the opportunity to ask any questions they might have about the project. The second purpose was to make parents familiar with the KnowledgeNET, including how to access pages and where to look for tasks and student work. The parents were given a password to give them access to all parts of the extension group pages except student journals. To access these they would need to ask their children for their password.

I e-mailed parents four times during the project to up-date them as to the group's progress. I had hoped that e-mail would provide me with feedback from the parents throughout the project but the parents proved reluctant to do this, with only three parents replying to my requests for comment. Several did however approach me personally to discuss the project when they saw me at school.

Guided Inquiry

This was definitely a guided rather than independent inquiry, although there were aspects of independent inquiry throughout the process. These students had been using the inquiry process for approximately 15 months prior to this unit. They were not at the stage where they had the skills to complete an independent inquiry.

This particular project does not fit any particular inquiry level (Herron, 1971) exactly. The project started as a Herron's level three open inquiry when students chose their own topic and question for inquiry. They then worked mainly at Herron's levels one and two (structured and guided inquiry) throughout the process, mainly guided by me but independent at times. At the product stage the students again worked at Herron's level three when they formed their own opinions related to their topics.

The students were given tasks to complete following their face-to-face sessions. The tasks were the result of the ongoing review of the inquiry and discussions with students as to the 'next step'. These tasks were posted on the KnowledgeNET where they could be viewed at home by the students and their parents. Timeframes for completion of tasks were given and links to related resources were included. Other scaffolding and support provided to the students is explained in the relevant sections.

Procedure

Students followed the Opoutere learning journey model (Appendix Four) throughout their inquiry. This appears as a linear model, but this is not the case in practice because of the ongoing review which is built in to all stages.

Online Journals

Students each had a journal on KnowledgeNET (see Fig. 9) which was used throughout the inquiry. Permissions were set for this page so that only myself and the students had access. I put the tasks for the following week or weeks on this page so that these could be accessed at home. This process took me 20-30 minutes for both groups once every one - two weeks as I could cut and paste onto each page. Students recorded some work here and some in the 'work in progress' pages. They also recorded their enjoyment and difficulty levels for the project (see Figs. 18 and 19) in the 'student views' section). Students also up-dated their bibliographies in this section.

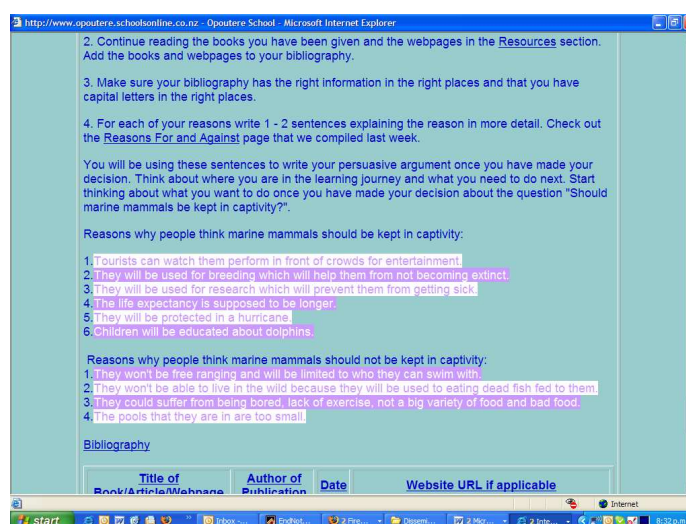


Fig. 9 Student journal

Students were able to ask questions here if they needed points clarified and I was able to give them feedback. I undertook to check the journals at least once every 2 days, but in reality I checked them most nights as I felt prompt feedback was important (Hattie, 2003). This took five - twenty minutes most nights depending on how much work they had completed.

The journals proved very useful for students to express any problems or fears they had without having to bring them up in front of their peers:

"I am ok with this, but I may have difficulty with anything to do with division" (Jay).

"Mrs K I don't know anything about Dolly the Sheep." (Jack)

Online Resources

The students were provided with a number of resources via the KnowledgeNET. These included links to websites (weblinks) related to the project (see Fig. 10) and information about aspects of the project such as the inquiry process and questioning (see Fig. 11). Assessment tools and some compilations of student investigations were also posted here. These are described in more detail later.

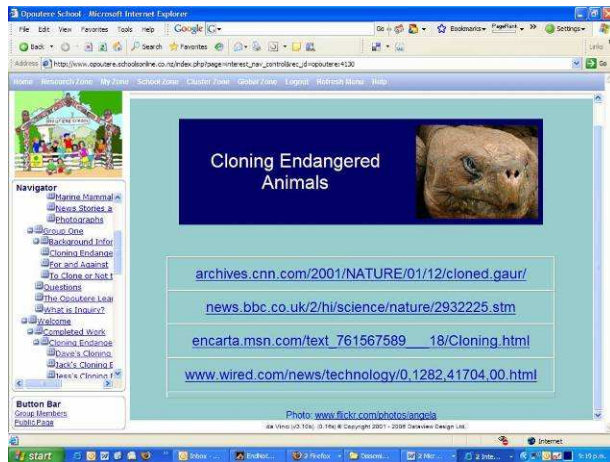


Fig. 10 Weblinks



Fig. 11 Resources section overview

The resources section proved very valuable when flooding caused a school closure on the last school day before the two week holidays. I had intended to spend this session introducing the students to the use of bibliographies so that they could begin work on these over the holidays. Instead I posted information and instructions about bibliographies in the resources section on the KnowledgeNET. The students were then able to begin their bibliographies. During the holidays I noticed that the students had misinterpreted my instructions about the date as referring to the date they read the book, rather than the publishing date. I was able to give them immediate feedback via their journals and alter my instructions. Two of the students referred to this as an aspect of the KnowledgeNET that made their task easier:

"We didn't have to have a visible teacher." (Amy).

"We didn't have to have a teacher in the classroom." (Bob).

Face to Face Sessions

Face-to-face sessions provided opportunities to reflect on the progress and process so far, this review process being an important part of the Opoutere learning journey. They also provided opportunities for group members to share information they had gained since the last session. Some websites were viewed and discussed at this time and the sessions were also opportunities to go over concepts which had proved difficult for the students to understand.

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These sessions took place two - three times per week for 26- 30 sessions and were about 30 - 40 minutes long. These units would therefore take six - ten weeks to compete in a normal classroom setting.

Initial Problems

There were some initial problems with students accessing their pages and forgetting their passwords. There were also difficulties with students creating new pages or forum topics instead of writing within an existing page or thread. These problems were resolved by the third session. Initially the students were using very informal text language in their conversations. We discussed the need to adapt the type of language used to the audience and that if they used text language I may not understand them and they reverted to more conventional text. The tone of their communications continued to be informal.

Four of the students had dial-up access at home. Three had broadband and one started with dial-up and got broadband towards the end of the project. Slow internet access at home was an issue for some students and this continued to be a problem for some. One student especially had a very slow internet speed and this slowed down the process of using the KnowledgeNET at home considerably. It also led to her choosing only to access the bare minimum of pages required when at home. She therefore did not look at sites or resources at home as other students did, except when this was essential for the task. One student had internet problems that meant she was unable to access the internet at home for most of the project.

The Inquiry Process

The Question

The process of deciding on the problem/question for inquiry was a little artificial because of the nature of this pilot project. Normally in class the problem or question arises more naturally, but in this case the students were asked to come up with a question for investigation on a topic of their choice. Firstly they brainstormed a number of topics of interest which were recorded on the ACTIVboard. The forums on KnowledgeNET were also used to allow students to post ideas on possible topics between sessions. Students then worked in their groups with the printed list of topics to decide on a topic that interested them all.

Group One had no difficulty doing this, agreeing very quickly on Cloning as their topic. They then used the forums to discuss and share possible questions for inquiry. At the same time I used the face-to-face sessions to discuss what constitutes a rich or fertile question (Harpaz & Lefstein, 2000) to aid them in framing their question. Characteristics of fertile questions were then posted in the resources section of the KnowledgeNET so students could access these

from home. After discussing several options, the students decided to explore the question “Should we clone endangered animals?”

Group Two had more difficulty as they could not initially agree on a topic. I then gave them a few magazine articles relating to various topics I thought might interest them, one of which was on orcas in captivity. Around the same time one of Marineland’s dolphins died and there was debate in newspapers and on T.V. about whether they should be allowed to replace it. The group decided this was what they wanted to investigate. Their question “Should Marineland be allowed to get a new dolphin?” arose from the debate in the media.

Prior Knowledge, Subsidiary Questions and Planning

Students initially brainstormed their prior knowledge individually on the laptops using the program Inspiration™. Both groups had very little knowledge about these topics, other than at a very superficial level (see Appendix Five). Group One students knew that cloning involved replicating something and two of them knew it involved DNA in some way, but that was basically the limit of their knowledge, other than some information (or in many cases misinformation) gained from Sci-fi movies.

Group Two students had a little more knowledge on their topic. Most knew the mammals were kept in large pools, were fed dead fish and were taught tricks. Some thought all marine mammals in captivity were sourced from the wild.

The next step involved compiling students’ knowledge using the ACTIVboard™ to get down ideas quickly. This was then transferred to a KWHL (What I **Know**, What I **Want** to find out, **How** I will find out and What I **Learnt**) graphic organiser on the KnowledgeNET so it could be accessed by students at home. This could have been typed straight onto the KnowledgeNET page but when getting down information quickly I find it easier to just write myself or have the students write their ideas, then I transfer it later.

Subsidiary questions were brainstormed and again recorded directly onto the ACTIVboard™ then transferred to the KWHL later. Having these permanently recorded was very useful as these were often referred to during the inquiry. The ability to move these items around on the ACTIVboard™ to sort them into categories was also useful. Students liked being able to use the ACTIVboard™ to write their ideas:

“We could brainstorm stuff then write it.” (Leopold)

“[We could] do brainstorms and come up individually which is way easier.” (Amy).

The students used the KWHL to record their ideas about where they could source information. This was their main form of written planning and there were several discussions about how they would find the information they needed. Group Two constructed a second KWHL on cloning of endangered animals once they had completed their background research on cloning. This was done because they felt the information they had collected on cloning was still not enough to answer their question about cloning of endangered animals. They felt they need more specific information on the topic.

Finding and Gathering Information

Resources

Two main sources of information were used, books and the internet. There were no books on the cloning topic in the school library and there were six books on marine mammals. There was one useful magazine article on orcas in captivity. Books were requested from the National Library in two separate lots as the books are only issued for one month loan. The first set had 10 books on cloning and 12 books on marine mammals. The second set had 10 books on each topic.

The cloning books proved very useful in the initial stages when students in Group One were finding out about the cloning process. In the second phase, when they were concentrating on cloning of endangered species, the books were of very limited use as only two books mentioned cloning of endangered animals at all and then only in a very brief paragraph. The internet had a wealth of information about cloning, including a very useful slide show which was used to help the students understand the process of cloning. Readability was an issue, but adding K12 to searches virtually eliminated this problem. When students moved to looking at how mammals were cloned there were a large number of pages on Dolly the sheep which proved useful. On the topic of cloning endangered animals there was less information, but there were still a number of useful pages able to be accessed.

The marine mammals' books from the National Library and school library provided useful background knowledge on marine mammals in the wild. Apart from one article on orcas in captivity, however, they did not provide any information about marine mammals in captivity. The internet proved to be a much more useful source of information.

Group One needed to find information specific to Napier Marineland. The internet again proved useful here as Marineland had an internet site. The students also e-mailed both Marineland and the Napier Council in order to gain further information and had replies from both. If Napier had

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been closer to the school than actual visits to Marineland and/or interviews with people involved would have been the best option. However, owing to the distance involved, this electronic communication proved to be the next best thing.

Two television channels TV1 and TV3 had news and current affairs items about Napier Marineland wanting to get a new dolphin. These items included interviews with the Marineland staff, the Council and groups opposed to a new dolphin being obtained. Some of the students viewed these programmes when they first aired on television but the others were able to view them later at school via the archived video footage on the www.nzzoom.co.nz and www.stuff.co.nz websites. These video clips proved to be valuable sources of information for the students.

Web Searches

The students mainly worked collaboratively in pairs on wireless laptops when searching the internet. This was because I believe working collaboratively to be the most effective way for students to work when in this stage of an inquiry (Cradler, McNabb, Freeman, & Burchett 2002; Dalton, Hannafin & Hooper 1989; Falloon 2004; Hooper, Temiyarkan & Williams, 1993; Inkpen, Booth, Klawe & Uptis 1995). I have found any more than two students to a computer often results in one student not being fully involved supporting Falloon's (1984) findings.

When the students were first interviewed part way through the project they mentioned they did not like sharing computers and would rather work individually, but when questioned further they said that they didn't mind sharing so long as they were able to work with their choice of partner. When they were able to choose who they worked with they saw benefits from sharing, as these comments from student interviews show:

"You can share your ideas and everything."

"If you don't know something the other person sitting next to you would know."

The wireless laptops were used extensively during this stage of the inquiry. The students had both desktop and laptop computers available to them but chose to use the laptops. When questioned about this all expressed a strong preference for laptops. These students had used laptops in their classrooms for 15 months prior to the start of this project so novelty is unlikely to have been a factor in their choice. The main reason given by students for preferring the laptops was their portability.

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"They are portable and you can use them anywhere, you don't need a wall or a plug." (Jess)

"Because you can take them anywhere, any time." (Jay).

"You can use them wherever" (Yoko)

One student chose to use a desktop during the early stages, but when questioned this was found to be because he was having trouble with the laptop mouse. Once given a USB mouse he preferred to use the laptops. I questioned all students about their preference for using a mouse or laptop touchpad and two preferred the USB mouse, one preferred the touchpad and five said they didn't mind either. However I gave them all the option of using a USB mouse and most chose to use it for most sessions.

The students used a combination of teacher-selected weblinks and free-searching using search engines (mainly Google™) on filtered internet to access information related to their questions. The weblinks were selected for the quality of information related to the topic and their readability. As mentioned, this was especially important for the group working on cloning. The main problem with providing weblinks for Group Two was finding a balance of views, as there were a large number of sites which were clearly anti keeping marine mammals in captivity and only a very small number presenting the other point of view. When selecting weblinks to post on the KnowledgeNET I was careful to present a balance of sites from both sides.

Students in both groups found the links (Fig. 12) helpful because it was quicker and easier to get to the relevant sites.

"Because it shortens the looonnnng journey to links!" (Dave).

"So we didn't have to go through Google™, click no, click no, click no, click no." (Yoko).

They also commented on the fact that they weren't having to read information that wasn't relevant to the topic.

"It was better because the answer was just there, it wasn't going on about something I didn't need." (Amy)

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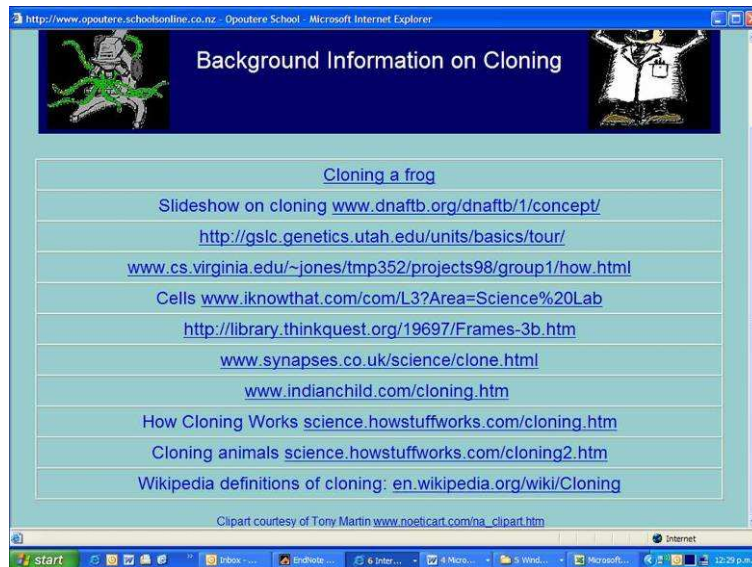


Fig. 12 Weblinks for cloning

The students also did some guided free-searching (i.e. without weblinks) for information because I considered it important they develop their search skills. (Jones, 2002, as cited in Kuiper, Volman, & Terwel, 2005). The searching was guided because I do not believe students of this age have the necessary skills for efficient, unsupported web-searching (Agosto, 2002; Fidel et al., 1999; Salomon & Almog 1998; Wallace, Kupperman, Krajcik, & Soloway, 2000; Watson, 1998). These students were mainly in the concrete operational stage of development where Hirsch (1999) believes students are unable to cope with the abstract concepts needed for independent web searches.

The students were given guidance to help decide on suitable keywords for searching and use of advanced search techniques such as using Boolean operators, adding K12 to search terms and putting speech marks around phrases. Some of the students were experienced at web searching and quite familiar with these techniques, while others needed a significant amount of guidance.

Students also needed guidance when applying the information to their question, as they tended to look for exact answer rather than deducing answers from information gathered. This agrees with the findings of Bilal (2001), Fidel et al. (1999) and Wallace et al. (2000).

I consider Internet safety is a significant issue when working with primary-aged students. The student's internet access at school was filtered using Schoolzone™. As students will not always have filtered internet, especially at home, the students were also taught internet safety skills. In year three they underwent a course of internet safety skills and gained their internet licenses and these skills are constantly reinforced by their class teachers.

The filtered internet does restrict access to some useful sites as well, most notably those like Google™ images. The settings can be adjusted if teachers require their students to have access to a blocked site. During this project no blocked sites were encountered so it was not an issue.

Reliability and accuracy of sources was an important consideration. I used the technique of asking students to confirm information from three different sources before accepting it. This proved useful as the students tended to just accept whatever was written on the first page they found. Watson (1998) mentions encountering similar issues with young students searching the internet.

Copyright and referencing issues are another area I consider important and hence I introduced the students to use of a basic bibliography. I felt this was a good introduction to students recognising the ownership of intellectual property. It was also a way of getting students to think about the currency of materials used, especially for topics such as cloning where scientific advances are continually being made.

The data projector was very useful at this stage to be able to share sites with students, we could all see the screen at once and this facilitated discussions about the information found. Using the ACTIVboard™ with the data projector made it very easy to access sites and links while still facing the students. The students and I could also use the pen to highlight pieces of information and record any useful information in the ACTIVboard™ flipcharts.

Sort, Sift and Analyse

Both groups were set tasks designed to clarify their understanding on their topics. Group One was having trouble understanding cloning near the start of the unit. In their KnowledgeNET journals the students were asked to write an explanation of the process to bring together the information they had gathered on the topic. It proved quite a difficult task and they needed a lot of support at this stage. All were eventually successful in developing their understanding to the stage where they could write this explanation and satisfy me that they understood what they had written.

Once Group One had developed an understanding of the basics of cloning they moved onto the topic of cloning endangered species and they compiled a 'for and against' list (see Fig. 13). This was initially done on the ACTIVboard™, being added to each session as new information was discovered, then transferred to the KnowledgeNET so it could be viewed at home by students.

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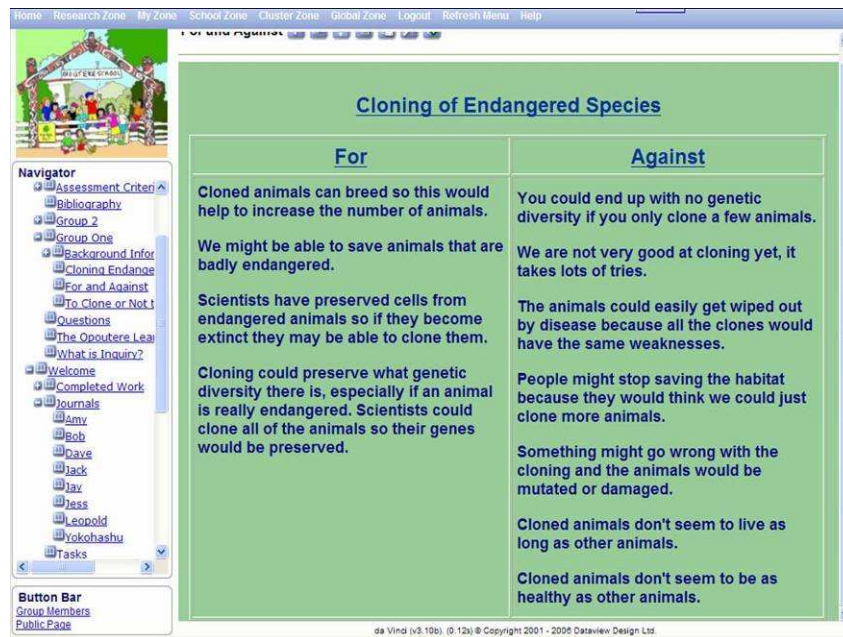


Fig. 13 For and against chart from KnowledgeNET

Group Two were asked to compile 'for and against' lists in their journals to help them sort their information. Initially these lists were very much based on opinion, rather than having any facts to back up their position. The students were guided to provide examples and facts to back up their arguments.

It was interesting to note that at the initial stage all the students in Group Two believed that marine mammals should not be kept in captivity, the opposite of their eventual decision. There were three main factors which appeared to influence their change in position. The first was finding out that the dolphins at Marineland had actually lived longer than the average life expectancy of dolphins in the wild. The second was viewing the TV One Close Up programme video on Marineland (http://tvnz.co.nz/view/tvone_minisite_story_skin/702755%3Fformat=html) where they learnt that Marineland cares for sick and injured animals (confirmed by a visit to the Marineland website and e-mail from Marineland) and they felt the video showed the keepers really cared about the dolphins. The third factor was the email replies they received from the Napier Council and Marineland where they found out that any new dolphins would not be sourced from the wild but would be captive-bred, and that the pools would be enlarged and upgraded before obtaining a new dolphin.

The students found having the resources available at home via the KnowledgeNET very useful at this stage of the process:

"It enabled us to form our own opinions." (Leopold).

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"It meant that we could [work] with our parents to decide on our own opinions.

(Amy)

"Very helpful because I felt much more comfortable here at home." (Dave).

The ACTIVboard™ was used extensively at this stage of the inquiry for students to record their findings (see Fig. 14) and to manipulate that information and apply it to their question. Students especially liked being able to use the board themselves.

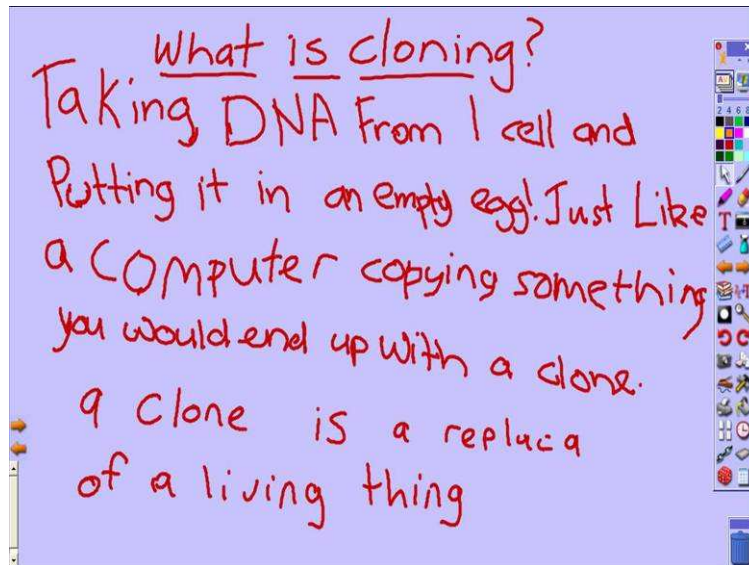


Fig. 14 ACTIVboard flipchart

Students also liked being able to see their ideas and other information on the big screen. This was the feature of the ACTIVboard™ that was most often mentioned by the students.

"It's bigger and everybody can see what you're doing." (Jack)

The students were asked to write persuasive arguments on their topics at this stage in order to help them come to a decision on their inquiry questions. I felt this would also help them to see if they had enough information on which to make the decision. The students were given criteria and exemplars of persuasive arguments taken from the TKI website (www.tki.org.nz). I used the ACTIVboard™ to go over the criteria and exemplars with students and to model an example, then create an example with the students.

The emphasis here was not on developing a beautifully crafted persuasive argument, but on having a basis for their decisions and backing up their arguments. The students then wrote their arguments in the work in progress section of the KnowledgeNET which meant they could work on it at home as well as at school. I gave them considerable feedback at this stage, both verbal and written, especially related to making sure they had facts to support their arguments. Several

students discovered they did not have enough information and returned to the 'finding and gathering information' stage.

Create and Communicate

The students were given free choice, within the restrictions of the school's available resources, of what they would do with the results of their inquiry. Both groups decided they wanted to make Powerpoint™ presentations which they would share with the school at assembly and publish in the public area of the KnowledgeNET so others could see the results of their investigations. Group Two also wanted to write letters to the Council and Marineland expressing their views. These were written in letter form but the students decided to email them so they would be received quicker.

Copyright issues, especially with students cutting and pasting chunks of information from the internet can be a problem at this stage of the process. However, the nature of the questions meant that this was not really possible, a distinct advantage of an inquiry topic over something like a more traditional project on dolphins for example.

The students were very much involved in making their own decisions about the question and had firm ownership of their conclusions. At this stage the students often used the KnowledgeNET resources section to access 'for and against' pages and the weblinks so that they could check the facts they were including in their presentations.

Both groups completed Powerpoint™ presentations on their chosen topics. I have seen many Powerpoint™ presentations by students where the whiz bangs and animations within the program are so attractive to students that they dominate the presentation. Jamie McKenzie (2000a) uses the term 'powerpointlessness' when referring to shallow presentations with poor clip art and too many bullet points. Additionally Mayer and Moreno (2003) demonstrated that cognitive overload occurs where there is input from too many multimedia sources. To prevent this from happening, the students were given criteria and a Powerpoint™ rubric that was created using Rubistar (<http://rubistar.4teachers.org/index.php>).



Fig. 15 Lungfish

Students were also asked not to use clipart, although use of photographs from the internet was permitted where they were appropriate and copyright free. Students drew their own illustrations (see Fig 15) and these were scanned and inserted into their presentations. A pen drive was used to transfer image files to save time logging computers on and off to access files via the server.



Fig. 16 Dolly v.1

One student chose to use the Paint™ program for some of his illustrations (see Figs. 16 and 17). He found this program useful as he was able to make slight alterations to the picture and save both versions.



Fig. 17 Dolly v.2

Students were asked that, where possible, they should talk to a small number of bullet points rather than read large amounts of text from the screen. At this stage Group One were beginning to go off onto a tangent about future possibilities for cloning and genetic engineering. We discussed this and decided that that once they had completed their 'Cloning of endangered species' Powerpoint™ presentations they would work on their thoughts about the future. They were very enthusiastic about this and developed a KnowledgeNET page each on the topic and then combined their ideas along with their illustrations into one Powerpoint™ presentation which they presented to the school assembly and made available in the public section of the KnowledgeNET.

Communication/Presentation/Action

Prior to presenting their completed Powerpoint™ presentations at the school assembly I videoed their practice presentations and the students then completed self and peer assessments using a rubric I provided. This proved to be very valuable and had a significant effect on the quality of presentations. One student for example was having trouble keeping still during the presentation, which would have been very distracting for an audience. Once he viewed the video he immediately picked up on this and significantly reduced the amount of movement. The feedback from their peers was also useful, especially with regard to volume and expression in their voices.

Students were given printed copies of their presentations so they could practice at home because several of them did not have the Powerpoint™ program on their home computers. This solution proved very satisfactory. Their Powerpoint™ presentations were also uploaded to the 'completed work' section of the KnowledgeNET. A Powerpoint™ viewer program was included so those without the program could still view the presentations.

When presenting to the assembly the students used the data projector and laptop to project their Powerpoint™ onto a screen so it could be viewed by the whole school at once. They also used a wireless mouse to change slides and had the laptop facing them so they could view their

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presentation without having to face the screen. This was very useful in ensuring they kept eye contact with the audience.

The students' Powerpoint™ presentations were uploaded into the 'public section' of the KnowledgeNET so that they were viewable by the general public. All the students thought it was important or very important that there was a place for their published work to be displayed.

"[It is] very important because it's where the whole world can see what we have done and they can see that we learned a lot during the whole process." (Dave).

Students were all given a CD to take home with their Powerpoint™ presentations, a copy of the Powerpoint™ viewer program and the video clips of their final presentation. This was done for two reasons: Firstly, one student was having internet access difficulties at home so could not access the KnowledgeNET and secondly this would mean students would be able to keep their presentation even after they leave the school and no longer have access to the school's KnowledgeNET.

Assessment

The students carried out peer and self assessments on their work using rubrics (see Appendix Nine) designed using Rubistar (<http://rubistar.4teachers.org/index.php>). The areas assessed were Powerpoint™ presentations, oral presentations and bibliographies. These rubrics made it very easy for students to carry out self and peer assessments, both formative and summative. Their final self assessments were recorded in their KnowledgeNET journals and could form a part of an e-portfolio along with their completed work and their journals.

Problems

At the end of the project the students were asked to record any problems they had encountered during their inquiry (at home or school) and to rate these from one (slight) to 5 (major). Two students reported no problems and two reported two problems, the others had one problem each (Table 3).

Table 3 Problems encountered by students	
Rating	Problem
4	Slow dial-up at the start
5	At the beginning I kept deleting all my work.
0	None
2	The Powerpoint™ took a while to load.
3	The screen froze
3	The loading (slow)
5	KnowledgeNET not accessible at home [home computer problem]
0	No problems
2	Computer turned off once [at home]
1	Battery ran out on laptop [needed recharging]

During face-to-face sessions there were no major issues encountered by me. There were occasional difficulties with students not being able to access a new KnowledgeNET page I had created because I had neglected to give them 'write access' to the page. This was easily fixed. There were a few occasions when a laptop had not logged on or off correctly which meant files were not saved to the server and hence were not accessible from all computers. A pen drive was used in these occasions to transfer the files.

Two students had problems accessing computers at home due to computer problems. For one this was for most of the project and for the second this lasted for a few weeks. Both completed their work at school or worked on paper versions of the tasks. This was a significant issue.

Evaluation of project

The extension group project was evaluated using the Galileo Educational Network Inquiry Rubric (2005) (Appendix eight) which looks at seven areas: Authenticity, academic rigour, learning in the world, appropriate use of technology, active exploration, connecting with experts and assessment. For each area there is a beginning, developing and accomplished stage.

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The Group One inquiry, working on whether scientists should clone endangered animals, fitted into the developing stage in all areas although some criteria of the accomplished stage were met in all areas except 'connecting with experts'. The only contact with experts had by the students in this group was via information presented on websites and in books, none were actually spoken directly either face to face or via electronic communication. This was mainly due to the lack of experts in these fields in the local area.

The Group Two inquiry investigating whether Napier Marineland should be allowed to purchase a new dolphin met the accomplished stage criteria for both 'authenticity' and 'academic rigour' and the developing stage criteria in all other areas. The 'accomplished' criteria were met for some aspects of each area except connecting with experts. It should be noted that this area in the rubric deals solely with face-to face interaction not interaction via means such as e-mail which was undertaken by this group.

In the area of 'authenticity' the Group One inquiry met the criteria of emanating from a question with meaning to students as the topic and question were selected by them. It also met the criteria of being a question likely to be tackled by adults in the community and indeed there are adults currently debating this topic. However it is unlikely the outcomes of their inquiry, have contributed to the world's knowledge, although it certainly contributed to the knowledge of the school community.

The Group Two inquiry met all criteria for the accomplished stage of 'authenticity' with their choice of inquiry. This topic is one that is being investigated by adults in the community and indeed as the inquiry was drawing to a close a petition on the topic was presented to parliament. The group took the opportunity to write to both the Napier City Council and the Conservation Minister putting forward the results of their research.

In terms of 'academic rigour' the students in both groups were definitely building knowledge rather than just acquiring or applying it. They were also continually asking questions of the information they found. Group Two were more independent in their inquiry, partly due to the nature of their inquiry which was less academically demanding than that of Group One.

Both groups met the accomplished-level criteria for 'learning in the world' by 'addressing a semi-structured question which was grounded in the life and work beyond the school'. For the next two criteria in this area the groups fell somewhere between the developing and accomplished criteria with some aspects of the inquiry being teacher-guided and other areas being independent.

In the 'appropriate uses of technology' section both groups used a variety of technologies at each stage of the inquiry. The decision about which technologies to use was sometimes teacher directed, and at other times students chose the technologies they would use. In the final 'create and communicate' stage of the inquiry for example, students were given a choice of a wide variety of technologies. Both groups conducted research, solved problems etc. and communicated with an audience outside the classroom via the KnowledgeNET public pages. Group Two went a step further with their e-mails to the Napier Council Conservation Minister concerning the results of their inquiry. Parents of both groups had online access to student's work throughout the project via the KnowledgeNET.

In terms of 'active exploration' and 'connecting with experts', Group Two went further than Group One who only used book and web resources. Group Two also used e-mail and information from T.V. programmes to supplement information from books, magazines and the internet.

The students received feedback throughout and at the end of this project from a range of self, peer and teacher assessments. Parents were also able to provide feedback via the KnowledgeNET. As mentioned previously reflection and review were an integral part of the process.

Enjoyment and Difficulty Levels

Going into the project the students had high levels of interest in the project and most were excited or happy to be a part of the project. Some were a little tentative at first as they were not sure exactly what they were letting themselves in for:

"I really like it!!!!!! I actually think that it's a good idea to do this. I hope we get to learn heaps of stuff like copying and all the rest." (Dave)

The students' enjoyment levels remained high throughout this inquiry project (see Figs. 18 and 19) with only one child's enjoyment level dropping below 6 and this only for one week. Average enjoyment levels for Group One ranged between 8 and 10 and for Group Two between 8.3 and 10. When asked to rate their enjoyment levels for the project as a whole every student rated this at 10/10. This was interesting because no individual section average scored this high.

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There was a wide range in the ratings for the difficulty level of the project. For Group One average difficulty levels ranged from 6 to 9.75 (10 being the easiest and 1 being the most difficult) with individual ratings ranging between 3 and 10. Several children recorded scores below 6, sometimes for several weeks in a row. For Group Two the average difficulty levels ranged from 8 to 9.3. Only one child in Group Two recorded a difficulty level below 6 and that was only for one week. The average difficulty level students gave for the project as a whole for Group One was 8 and for Group 2 it was 9. The greater difficulty levels for Group One reflected the more complex nature of their topic.

The difficulty ratings and enjoyment ratings were a very useful guide for me as I could make adjustments to my teaching if the ratings began to drop. For instance, when Group One recorded greater difficulty level ratings early in the inquiry it was because they were having trouble understanding the cloning process and I was able to do extra work with them on this during the face-to-face sessions.

The difficulty ratings for individual students did not always reflect how much trouble they were having with the work. One student, for example consistently recorded having difficulty but was coping well with the work. When questioned, the student said the quantity of reading required was the issue. Another student consistently recorded difficulty levels of between 8 and 10, but was struggling with some concepts in class. Mostly however the difficulty levels were a useful indication of the students need for support.

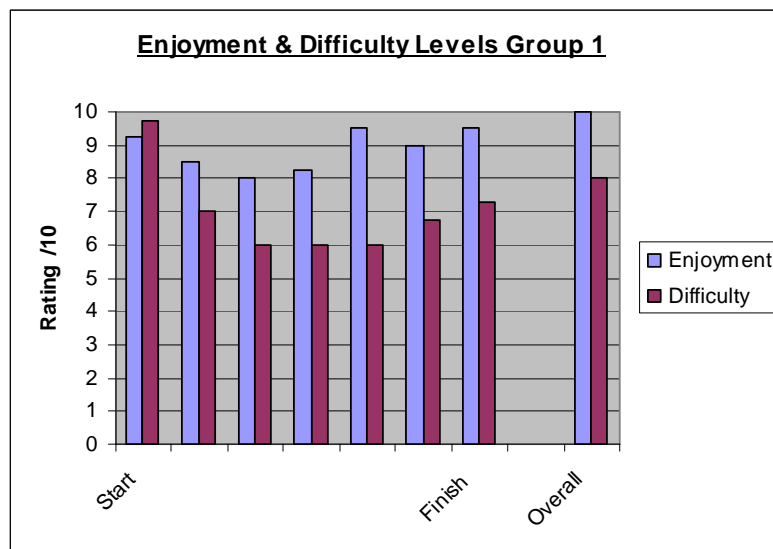


Fig. 18 Group One average enjoyment and difficulty levels

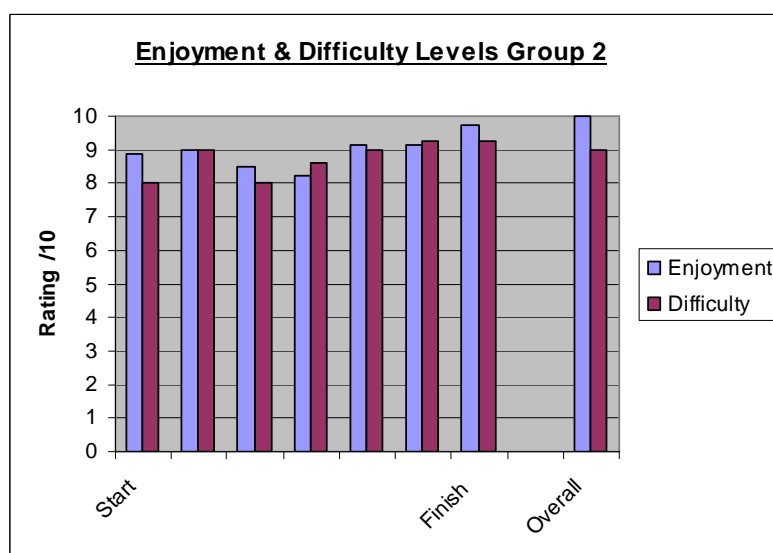


Fig. 19 Group Two average enjoyment and difficulty levels

Books versus Internet

When asked whether they preferred the internet or books for their research, five students preferred the internet and three were happy with either. All found books useful at times. This agrees with the findings of Large & Beheshti (2000) that students liked to use both the web and books but generally preferred the internet. Some positives given for books were:

“They don’t have those stupid ads that pop up on the screen.”

“You just have to pick up the book and look at a page.”

“You don’t have to turn it on.”

“They are easy to find sometimes. So long as you don’t have to go to the library and go through all the books.”

"Because of the pictures"

On the other hand they felt the net was faster and easier to use to find information, that the information was more up-to-date and that there weren’t many good books. The ability to print pictures and information from the internet was also mentioned as a plus. Those who opted for both felt that the internet and books were both good sources of information. The students in this study were given access to books and the internet and used both.

Powerpoint™ Presentations

The students all chose to use Powerpoint™ to aid their presentations after being given free choice of how they would communicate their findings to the school. Several of them made

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comments about how they felt that presentations without using Powerpoint™ were speeches and they did not like speeches.

“No speech. YAY!!” (Amy)

“I hate doing speeches. Simple as that... (Yoko)

They found the Powerpoint™ slides were useful to jog their memories then they could talk to the bullet points:

“I get up and I can’t remember the words and everything and so I find Powerpoint™ a big help.” (Yoko)

“You could keep your information and you could like elaborate on it... You could elaborate on bullet points.” (Group 2 student)

Being able to show the Powerpoint™ on the big screen was considered helpful:

“If we didn’t [use Powerpoint™] it would be hard to see, there’s a much bigger screen.” (Group 1 student)

They also commented on the fact that Powerpoint™ gave their audience something to look at and supported their presentation:

“Instead of them all concentrating on you they can read the screen and hear you.” (Group 2 student)

“Powerpoint ’s more visual.” (Dave)

“Yeah, a lot more visual and you have the pictures to show them what things look like instead of describing things.” (Group 1 student)

“People could actually see what you were saying. They could actually get a visual and a hearing thing.” (Group 2 student)

“It’s 21st century. Speeches are like 8th century.” (Group 2 student)

ICT Ratings

The students were asked at several times during the project to rate the helpfulness of the ICTs and how much easier or harder ICTs made their work (See Fig. 20 - 25). The computers and internet were found to have been helpful or very helpful by all students at all stages of the

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project. All students thought the internet made their tasks easier or much easier at all stages of the inquiry.

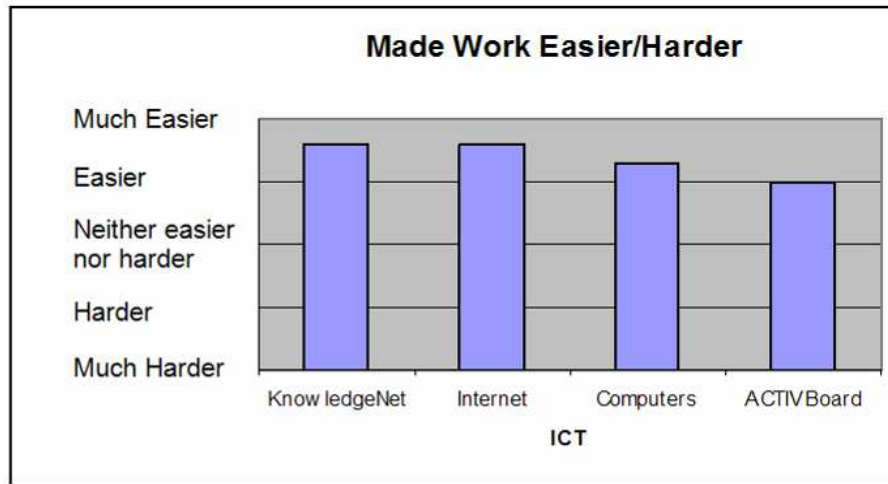


Fig. 20 Students perceptions of how much easier or harder ICTs made tasks

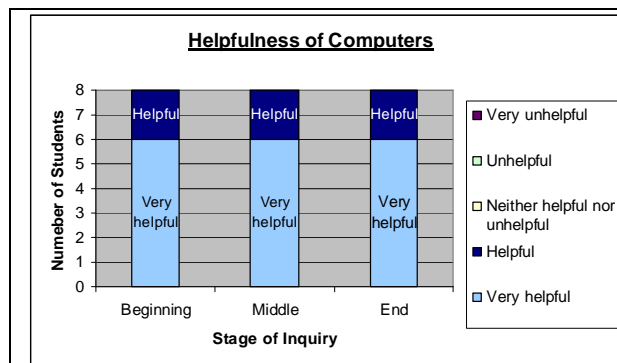


Fig. 21 Students perceptions of helpfulness of computers

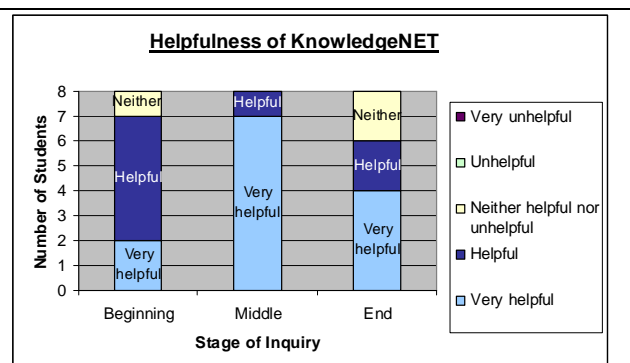


Fig. 22 Students perceptions of helpfulness of KnowledgeNET

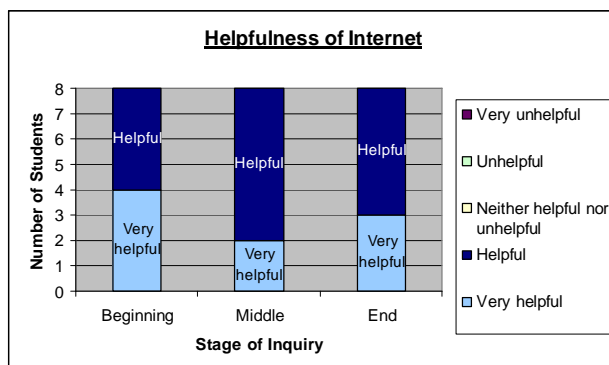


Fig. 23 Students perceptions of helpfulness of internet

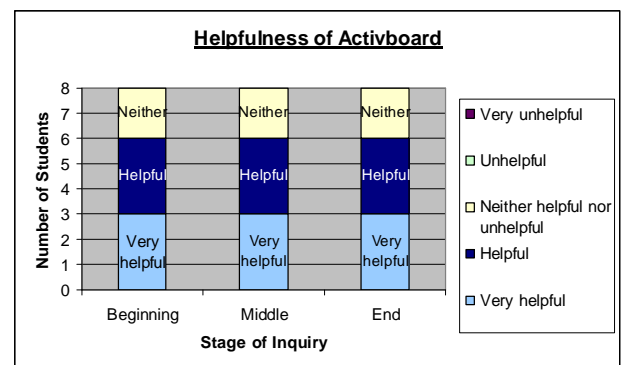
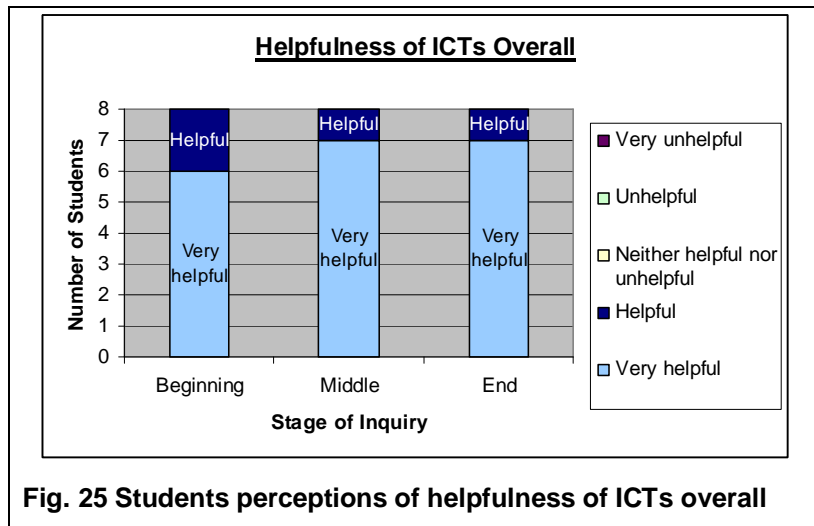
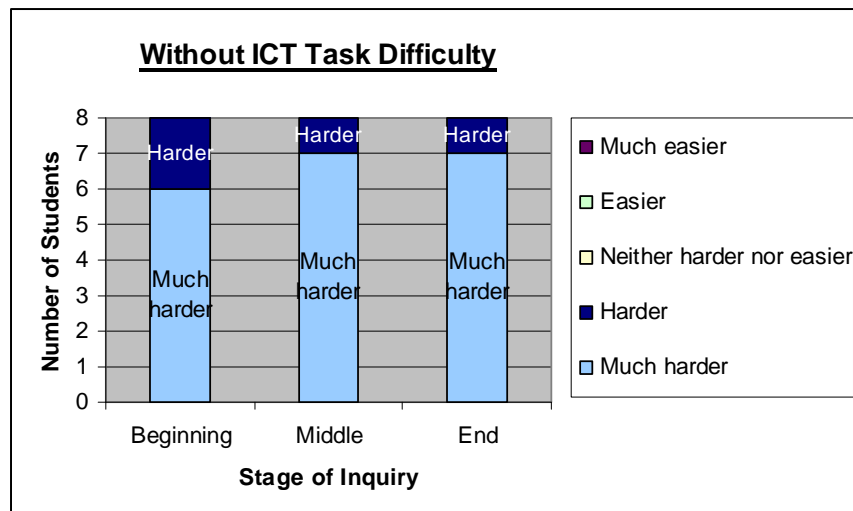


Fig. 24 Students perceptions of helpfulness of ACTIVboard™

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Students were also asked how much easier or harder their tasks would have been without ICT (see Fig. 26). Most thought their tasks would be much harder without ICT.



Students commented:

"Without ICT it would be soooo hard!" (Yoko)

"[Without ICT it would be] HARDER! because we couldn't find stuff you wouldn't find in books... because it's like having no electricity and what a life that'll be. Just like the stone age." (Dave)

"We wouldn't have all the information and we would have to write everything by hand. The computers made it really easy and it would have been hard without it." (Jess)

Decision-making

The students were asked what helped them come to a decision in their inquiry and they mentioned a number of factors including:

Group One

- Research
- Thinking about the pros and cons
- Using the For and Against (on the ACTIVboard™ and then on the KnowledgeNET)
- Websites
- Books

Group Two

- Internet
- Stuff News website and NZoom News (the TV1 website) video clips
- TV
- The teacher
- Weblinks (on the KnowledgeNET)
- Each other – *“each one had different bits of information.”*
- Brainstorms
- Google™
- KnowledgeNET

Most useful ICTs

The item of ICT the students found most useful was the computers, especially the laptops, (see Table 4), mainly because computers gave them access to the internet. The other main reason given was that they preferred typing to writing information out by hand. Half of the students said they preferred typing to writing and the other four said they didn't mind either. Other useful ICTs are shown in the table.

“We wouldn't have all the information and we would have to write everything by hand. The computers made it really easy and it would have been hard without it. We didn't have to write it all out on paper and it saves trees.” (Jess)

“[The KnowledgeNET was] very important, because it's where the whole world can see what we have done and they can see that we learned a lot during the whole process and it was neat.” (Jay)

Table 4 ICTs students considered most useful for inquiry	
Student	ICTs
Jess	Computers
Yoko	PCs to access KnowledgeNET, Powerpoint™ , internet
Dave	ACTIVboard™ and Laptops
Jack	Computers
Leopold	Laptops
Amy	Word, ACTIVboard, laptops, Internet Google™
Bob	Internet, scanners, laptops Powerpoint™
Jay	Powerpoint™ and laptops

The Project as a Whole

Overall the students were very positive about the project as evidenced by their enjoyment levels (see Figs. 18 and 19). They all commented on how much they had enjoyed it and that they had learnt a lot during the process:

"It has made learning and homework a whole lot easier."

"Fun. Cos it was different and I liked how we used the computers."

"Really fun. We made up our own ideas. You didn't tell us what to believe."

"It made us think about thinking."

"You didn't tell us what to think we could think for ourselves."

"It was kinda fun learning all that stuff cos I didn't know about that and now I really want Marineland to get a new dolphin because it's kind of sad."

Conclusions and Discussion

Inquiry Learning

My first research question looked at teacher definitions of inquiry. There were several common elements in the teacher definitions and beliefs about inquiry. These were:

- ◆ Authentic, meaningful learning
- ◆ Students constructing meaning or understanding
- ◆ An inquiry or investigation into a question, problem, conflict or idea.
- ◆ Student-centred learning
- ◆ Student ownership
- ◆ Scaffolding to support learning
- ◆ Teacher modelling
- ◆ Teacher having the role of guide or facilitator

In relation to Harpaz's (2003) three elements of thinking the majority (but not all) of the teachers agreed more strongly with statements relating to teaching of thinking skills, than to statements relating to knowledge construction and student-centred learning. The area of New Zealand teachers' beliefs about inquiry-based learning is one that seems to merit further study.

The inquiry models being used by the teachers I interviewed were all information literacy based models. All models included the following stages:

- ◆ Motivation/immersion/knowledge bomb
- ◆ The question/problem/task
- ◆ Prior knowledge
- ◆ Plan
- ◆ Find and gather information
- ◆ Sort, sift and analyse information
- ◆ Construct and apply new understanding
- ◆ Synthesise/create
- ◆ Communicate and or take action
- ◆ Evaluate
- ◆ Reflect and review throughout process.

The discussion relating to action at the end of the inquiry raised some interesting points. If the meaning of action included communication of students' findings, then all teachers and students believed this was important. If it meant some form of social action, then the teachers believed

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that this should only happen if it was a natural result of the inquiry, there should not be a requirement for social action. Within the case study groups there were examples of both types of action. Both groups communicated their findings to the school and then to the wider public on the public pages of the KnowledgeNET. Group Two took social action when they sent e-mails to the council and Marineland regarding their findings (see Appendix Six).

All teachers were using some form of guided inquiry. They all felt strongly that there was a need to scaffold the learning for primary-aged students for both the inquiry process and use of ICT, especially the internet. They gave their students guidance at all stages of the inquiry process, with the amount and type of guidance being related to students' needs.

Case Study

The main ICT's which were used to support student inquiry in this case study were an ACTIVboard™ interactive whiteboard, data projector, wireless laptop computers with filtered Broadband internet (through Schoolzone™) and the school KnowledgeNET. The only other ICT hardware items used were a scanner and a pen drive. The software programs used were Inspiration™, Microsoft Word™ and Powerpoint™.

In terms of my research question concerning ways that ICTs were used by teachers and students to support the inquiry process, these ICTs supported the inquiry in seven main ways: as tools for obtaining, recording, sorting and presenting information, to aid understanding of complex concepts, to aid decision-making, providing access to primary sources, providing information on current topics, developing home-school partnerships and facilitating communication with an audience outside the school.

- **Tools for obtaining, recording, sorting and presenting information** – the ICTs were used and found to be helpful at all stages of the inquiry process.
- **Understanding complex concepts** - a combination of internet tutorials such as the one at <http://learn.genetics.utah.edu/units/basics/tour/> information from websites, information in books and good old-fashioned discussions led to the year 6 & 7 students developing an understanding of the complex concepts surrounding the topic of cloning.
- **Decision-making** - information from books, websites, discussions and e-mailing people involved, aided the students in making decisions about questions they had asked. This was especially noticeable with Group Two who changed their original opinions based on the information they discovered.
- **Providing prompt access to primary sources of information** - by e-mailing the people involved the students were quickly able to gain answers to some of their questions. Websites were also a major source of information (which was cross-checked)

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and in some cases were primary sources of information where the sites were developed by the people involved, rather than by a third party.

- **Providing access to information on current topics** – both topics, being very current, were hard to resource using traditional sources. Most information, other than background information, came from websites and e-mail.
- **Developing a home-school partnership** - Parents and students were very positive about the ways the KnowledgeNET provided a link between home and school.
- **Communicating findings to a wider audience** – the KnowledgeNET, and to a lesser extent e-mail, provided a medium for students to communicate their findings to an audience far wider than their school.

The students perceived that ICTs aided them in completing their research tasks and in making a decision about their research question. They believed their tasks would have been much harder without ICT.

Case Study Issues and Recommendations

The ICTs used in this project proved helpful at all stages of the inquiry, especially during the 'find and gather' and 'create and communicate' stages. They would all be useful additions to a classroom where inquiry-based learning was being implemented.

The internet was an extremely valuable resource for these inquiries. In my opinion neither of these inquiries could have been completed satisfactorily without it. Current topics such as these are extremely difficult to resource using traditional information sources, especially for primary-aged students where reading age of material is an issue. This is especially true for students living in isolated rural areas where ready access to experts and large libraries is difficult. If we are to allow for authentic learning where students inquire into areas that have meaning to them, then some topics are going to be hard to resource in a timely fashion without access to the internet.

The use of the internet in this way for student inquiry makes the teaching of critical thinking skills extremely important. Students need to be able to check the reliability of information sources and examine conflicting points of view carefully in order to make decisions in relation to their inquiry. The large amount of information available on the internet is both a plus and a minus. If students are not taught the skills necessary to deal with this information they could easily be overwhelmed by it (Agosto, 2002; Bilal, 2001; Fidel et al., 1999; Salomon & Almog, 1998; Wallace, Kupperman, Krajcik, & Soloway, 2000; Watson, 1998).

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Use of the KnowledgeNET for these inquiry projects was very helpful for both students and myself as the teacher. The weblinks, resources, online journals, forums, anytime anywhere access (for both teacher and students) and the avenue for publishing completed work, were all useful aspects that aided the inquiries. For teachers with few classroom computers and/or where students have limited access to high-speed internet at home, all aspects except the online journals could easily be managed, and would provide major benefits to students during their inquiries. This would also provide good links between home and school for those students with internet access.

However, using the KnowledgeNET, or another LMS, in the extensive way it was used by these groups with students completing the majority of their work online, would not, I believe, be easily transferable to a whole class situation, unless a high percentage of the class had internet access at home. It would also be desirable that most had fast internet to avoid the problems of slow loading of pages mentioned by some students. While it is possible to provide for those students without access, by giving time at school and by providing paper copies of some resources, this would become unwieldy if more than a few students needed this. This is especially true if one takes into account the fact that at any one time it is likely some students will have technical issues with their home computers which make internet access difficult. This was certainly the case during this project and echoes concerns voiced by the teachers I interviewed.

I would, however, recommend similar two-way use of the KnowledgeNET, or a similar LMS, in a small group situation either within the class eg. a guided reading group or as a withdrawal group eg. a group of GATE students, as was done in this project. The ability to interact with students via the KnowledgeNET and the home-school partnerships this developed were very worthwhile features. In a small group situation the problems of home internet access could easily be overcome by allowing students class time to complete tasks. Advances in internet speed and the continual lowering of the costs of home computers and internet access is likely to make this type of project in a whole class situation a lot more feasible in the near future.

ICT-rich Environment Issues and Recommendations

When deciding what an ICT-rich environment should look like we need to ask ourselves what tools we need to facilitate inquiry-based learning. We need to ask what tasks students need to complete, what kinds of thinking they need to do, what strategies they need to employ and how technology can help.

Computers ... are not rescuing the school from a weak curriculum, any more than putting pianos in every classroom would rescue a flawed music program.

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Wonderful learning can occur without computers or even paper. But once the teachers and children are enfranchised as explorers, computers, like pianos, can serve as powerful amplifiers, extending the reach and depth of the learners. (Kay, 1991, p.6)

My research questions looked at how teachers and students used ICTs to support their students' learning when involved in the inquiry process and what were their perceptions of this use? The teachers and students in this study were using a range of ICTs to implement inquiry-based learning. The main ICT items used were internet-capable computers (student to computer ratio between 1:1 and 1:4.8 in the classroom), interactive whiteboards, data projector, online learning management systems (KnowledgeNET and Moodle), digital cameras and a variety of software programs. These items were used by teachers throughout the inquiry process. Students also used these ICTs throughout the process but their use was more frequent during the 'find and gather information' and 'create and communicate/take action' stages.

Overall both teachers and students were very positive about the use of ICTs to support inquiry-based learning and found them helpful. There were some technical issues but, other than students' issues with internet at home, these were not seen as major problems. For teachers and students the most useful items of ICT were the internet and the computers used to access it.

Computer Ratios

Based on the results of my research and the existing research on this topic I have come to the conclusion that a ratio of 1:2 internet-capable computers to students is the ideal ratio to aim for in the classroom when implementing inquiry learning and that 1:6 should be the minimum if there is to be any significant effect on student learning. This is not to say that inquiry learning cannot be implemented using fewer computers, there are many teachers doing so with only one computer in their classrooms, but it requires a lot more effort and careful timetabling.

This does not mean that there needs to be 12 - 15 computers in every classroom. This would be an unrealistic expectation for many schools. My suggestion would be a 1:6 ratio in the classroom and then a shared mobile pod of wireless laptops to bring the ratio down to 1:2 when needed. This solution is a lower cost alternative, takes less space and the computers would be able to move to areas of need rather than lying idle (McKenzie, 2001). Given that in 2005 New Zealand schools had an average ratio of 1:5 computers including administration computers (2020 Communications Trust, 2005), achieving a 1:6 ratio in classrooms should be achievable for most schools, especially as the costs of computers continues to decline.

Other ICTs

The other ICTs mentioned by all teachers as being very useful were interactive whiteboards with data projectors. The teachers with these boards expressed very strongly that they found these extremely useful for implementing inquiry with all calling these, along with the internet, their most useful tools for inquiry. My own experiences with the case study groups support this finding.

Several teachers also mentioned the benefits of students being able to share information with the help of the data projector. This agrees with Woolsey and Bellamy's (1997) findings that the data projector facilitated student collaboration and group inquiry.

With the exception of one teacher, who had an excellent student to computer ratio and all students with home access to the internet, teachers with an LMS found similar benefits and difficulties to those encountered in the case study. The majority of the use of the LMSs was one way, with the teacher supplying resources, tasks, weblinks etc. and students only completing small amounts of work on the LMS. The teachers were all very positive about the benefits of using their LMS in this way. Students and teachers liked the links between home and school provided by the LMS. The main barriers to extended use of the LMS were limited student access to internet-capable computers both at home and at school.

Other Issues

The major issue encountered by teachers and students when implementing inquiry-based learning related to times when the technology did not work as expected. In most cases these were only minor difficulties but they could at times be very frustrating. Difficulties accessing the internet caused the most disruption to programmes, although teachers noted this did not happen very often. Teachers mentioned the need to be flexible and have a back-up plan for when things went wrong. They also mentioned that these difficulties became less of an issue as their own technical expertise grew. The availability of technicians was an issue for some teachers with the main problem being delays caused by technicians not often always being on site when needed.

Technical issues caused only minor problems when I was working with the case study groups. Students mentioned a number of technical problems they encountered at school but these were all of a minor nature. Difficulties at home with internet access, as previously discussed, were more of a problem for some students.

Internet safety was an issue for these teachers and along with teaching safety skills, internet filtering was used by all the schools. For some this raised the issue of sites being blocked that

were useful for inquiry. This concurs with Bauer & Kenton's findings (2005). In some cases the level of filtering applied was causing useful sites to be blocked along with the undesirable. All the schools had the ability to change these settings but this was often the job of the school's technician who was not always available.

Limitations of Research

The case studies only involved only a small number of students (eight) from one school. The questionnaire results from the three classes (two schools) did seem to support the findings from the case study group. This, combined with the effects of putting them in two separate groups who conducted separate inquiries, and considering the results for the teacher survey, did help to substantiate the findings. All their teachers had constructivist beliefs and were confident ICT users and these are likely to be important factors in how ICT was used in their classrooms (Becker, 2000). Further research is needed, to see if the views of these students are representative of all students undertaking inquiry in ICT-rich environments.

The small number of teachers interviewed and that they were not randomly selected, are limitations. These teachers were all enthusiastic and very competent users of ICT who had been using ICT in their classrooms for at least three and a half years, and in some cases over ten years. Their definitions of inquiry and descriptions of their classroom practice indicate they are strongly constructivist. These teachers would fit in stage six on Knezek and Christensen's (1997) stages of technology adoption. Teachers who are less confident and confident with ICT may have had a different view of the usefulness of ICTs but would also be less likely to be working in an ICT-rich environment.

As this was a participant case study then my own biases will be reflected in my findings. I consider myself a confident and competent user of ICT and certainly would be considered an early adopter, having used ICT in the classroom for over 20 years. Less experienced teachers may have encountered more technical difficulties than I did.

Recommendations for Further Research

Extending the study to include a larger number of teachers would help to substantiate the findings. It would also be useful to ensure a range of teachers were surveyed, including those teaching a range of class levels and with a range of experience using ICTs, or even those undertaking such approaches with minimal or no ICT.

In the case study recommendations I suggested that this pilot programme would best be conducted in a small group situation either within a class or as a withdrawal group. Extending the research to include case studies of inquiry in whole class situations would be useful, as would research on small groups undertaking inquiry within a classroom rather than being withdrawn. It could also be useful to repeat the study with a range of student age groups.

There was some variance in teacher beliefs related to inquiry-based learning. Study of New Zealand teacher beliefs about inquiry and what these look like in classrooms would seem to be worthwhile.

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Appendices

Appendix One: First Teacher Questionnaire

Class level: (tick all those which apply)

☐ Y0 - 2 ☐ Y3 - 4 ☐ Y5 - 6 ☐ Y7 - 8 ☐ secondary

Number of students in your class: _____

Hardware

Please indicate the hardware you use to implement the **inquiry** approach to learning. When considering how often the hardware is used indicate **typical use** during an **inquiry** unit of work.

	<u>How many of these do you use?</u> A: In your room B: Outside but readily available C: Outside but not readily available	<u>Frequency of Use:</u> 0= Not used 1= less than once a week 2= 1 - 2 times per week 3= 3 - 4 times per week 4= daily	<u>Usefulness:</u> 0= Not used 1= Not Useful 2= Slightly useful 3= Useful 4= Very useful
Desktop computers with internet access	A:	A:	A:
	B:	B:	B:
	C:	C:	C:
Desktop computers and/or laptops without internet access	A:	A:	A:
	B:	B:	B:
	C:	C:	C:
Wireless laptops with internet access	A:	A:	A:
	B:	B:	B:
	C:	C:	C:
Non- wireless laptops with internet access	A:	A:	A:
	B:	B:	B:
	C:	C:	C:
Interactive Whiteboard	Brand: _____		

Please list any other ICT hardware items you have found very useful when implementing inquiry learning:

Internet Access

Which of the following do you have access to in your classroom? (Select all that apply)

☐ Dial-up internet ☐ Broadband (or similar) ☐ Wireless internet ☐ School network

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Software

Please indicate the software you use to implement the **inquiry** approach to learning. When considering how often the software is used indicate **typical use** during an **inquiry** unit of work.

<u>Software/Application</u>	<u>Frequency of Use during inquiry unit:</u> 0= Not used 1= less than once a week 2= 1 - 2 times per week 3= 3 - 4 times per week 4= daily	<u>Usefulness for inquiry:</u> 0= Not used 1= Not Useful 2= Slightly useful 3= Useful 4= Very useful	<u>Comments</u> Any comments on the use or usefulness of the program or factors affecting its use or usefulness. Continue on back if necessary
Word or similar word processing program			
Excel or similar spreadsheet program			
Powerpoint™ or similar			
Access/Works or similar database program			
Inspiration/ Kidspiration or similar mind-mapping software			
Moviemaker/i-movie or similar video editing program			
Photostory or similar			
Paint/Art Rage or similar			
Flash or similar			
Frontpage/Dreamweaver/ or similar web-editor			
KnowledgeNET			

Moodle			
Schoolzone			
Video-conferencing			
Internet filtering software eg. Campus Net, Net Nanny			
Internet Explorer, Safari, Firefox, or similar program to access the internet.			
Encyclopaedias on CD-rom			
Information CD-roms eg. Wild South N. Z .Birds			
Other: (Please name)			

Do you consider you teach in an ICT-rich environment?

☐ Yes

☐ No

Inquiry Learning in an ICT-rich Environment

What is your definition of an ICT-rich environment?

Inquiry Learning

1. Which of the following pre-designed Inquiry-based models have you **heard of**?

- | | |
|--|--|
| <input type="checkbox"/> Big 6 (Eisenberg & Berkowitz) | <input type="checkbox"/> Research Cycle (Jamie McKenzie) |
| <input type="checkbox"/> Action Learning (Gwen Gawith) | <input type="checkbox"/> SAUCE (Trevor Bond) |
| <input type="checkbox"/> Others (name) _____ | |

2. Which of the following pre-designed Inquiry-based models have you **used**?

- | | |
|--|--|
| <input type="checkbox"/> Big 6 (Eisenberg & Berkowitz) | <input type="checkbox"/> Research Cycle (Jamie McKenzie) |
| <input type="checkbox"/> Action Learning (Gwen Gawith) | <input type="checkbox"/> SAUCE (Trevor Bond) |
| <input type="checkbox"/> Others (name) _____ | |

3. If your school has their own inquiry model please outline the steps in this model or attach a copy.

4. When considering various aspects of ICT and their use in inquiry-based learning please comment on any advantages and/or disadvantages in comparison to implementing inquiry-based learning without ICT. Continue on the back if necessary.

Disadvantages:

Advantages:

5. When considering various aspects of ICT and their use in inquiry-based learning please comment on any problems you have encountered and any solutions you found. Continue on the back if necessary.

Problems:

Solutions:

Comments: Please include any other comments you have about your use of ICT to implement inquiry-based learning. Continue on the back if necessary:

Appendix Two: Second Teacher Questionnaire and Interviews

Time you have been teaching in an ICT-rich environment _____ years _____ months

1. Please see how closely these statements fit with your beliefs about inquiry-based learning. Tick the box that best fits your beliefs.

1. "Inquiry" is defined as "a seeking for truth, information, or knowledge -- seeking information by questioning." (www.thirteen.org/edonline/concept2class/inquiry/index.html)

<input type="checkbox"/>	Strongly disagree	<input type="checkbox"/>	Disagree	<input type="checkbox"/>	Neither agree nor disagree	<input type="checkbox"/>	Agree	<input type="checkbox"/>	Strongly agree
--------------------------	--------------------------	--------------------------	-----------------	--------------------------	-----------------------------------	--------------------------	--------------	--------------------------	-----------------------

Comments

2. "For the teacher, inquiry-based education ends their paradigm of talking to teach and recasts them in the role of a colleague and mentor engaged in the same quest as the other younger learners around." (www.ncsa.uiuc.edu/Cyberia/DVE/FusionDVE/html/inquiry_based_education.html)

<input type="checkbox"/>	Strongly disagree	<input type="checkbox"/>	Disagree	<input type="checkbox"/>	Neither agree nor disagree	<input type="checkbox"/>	Agree	<input type="checkbox"/>	Strongly agree
--------------------------	--------------------------	--------------------------	-----------------	--------------------------	-----------------------------------	--------------------------	--------------	--------------------------	-----------------------

Comments

3. "Inquiry implies emphasis on the development of inquiry skills and the nurturing of inquiring attitudes or habits of mind that will enable individuals to continue the quest for knowledge throughout life". www.thirteen.org/edonline/concept2class/inquiry/index.html

<input type="checkbox"/>	Strongly disagree	<input type="checkbox"/>	Disagree	<input type="checkbox"/>	Neither agree nor disagree	<input type="checkbox"/>	Agree	<input type="checkbox"/>	Strongly agree
--------------------------	--------------------------	--------------------------	-----------------	--------------------------	-----------------------------------	--------------------------	--------------	--------------------------	-----------------------

Comments

4. Inquiry is not so much seeking the right answer -- because often there is none -- but rather seeking appropriate resolutions to questions and issues. (www.thirteen.org/edonline/concept2class/inquiry/)

<input type="checkbox"/>	Strongly disagree	<input type="checkbox"/>	Disagree	<input type="checkbox"/>	Neither agree nor disagree	<input type="checkbox"/>	Agree	<input type="checkbox"/>	Strongly agree
--------------------------	--------------------------	--------------------------	-----------------	--------------------------	-----------------------------------	--------------------------	--------------	--------------------------	-----------------------

Comments

5. Inquiry is a systematic investigation or study into a worthy question, issue, problem or idea. www.galileo.org/inquiry-what.html

<input type="checkbox"/>	Strongly disagree	<input type="checkbox"/>	Disagree	<input type="checkbox"/>	Neither agree nor disagree	<input type="checkbox"/>	Agree	<input type="checkbox"/>	Strongly agree
--------------------------	--------------------------	--------------------------	-----------------	--------------------------	-----------------------------------	--------------------------	--------------	--------------------------	-----------------------

Comments

6. The reason for proposing inquiry in our schools is that we want students to engage in authentic, real investigative work that reflects the real work of the living discipline. www.galileo.org/inquiry-what.html

<input type="checkbox"/>	Strongly disagree	<input type="checkbox"/>	Disagree	<input type="checkbox"/>	Neither agree nor disagree	<input type="checkbox"/>	Agree	<input type="checkbox"/>	Strongly agree
--------------------------	--------------------------	--------------------------	-----------------	--------------------------	-----------------------------------	--------------------------	--------------	--------------------------	-----------------------

Comments

7. Emphasis is placed upon the process of thinking as students interact with issues, data, topics, concepts, materials and problems. www.sasked.gov.sk.ca/docs/policy/ince1/section_4.html

<input type="checkbox"/>	Strongly disagree	<input type="checkbox"/>	Disagree	<input type="checkbox"/>	Neither agree nor disagree	<input type="checkbox"/>	Agree	<input type="checkbox"/>	Strongly agree
--------------------------	--------------------------	--------------------------	-----------------	--------------------------	-----------------------------------	--------------------------	--------------	--------------------------	-----------------------

Comments

8. "... where we can create opportunities for students to be engaged in active learning based on their own questions." <http://inquiry.uiuc.edu/whatsnew/workshop.php>

<input type="checkbox"/>	Strongly disagree	<input type="checkbox"/>	Disagree	<input type="checkbox"/>	Neither agree nor disagree	<input type="checkbox"/>	Agree	<input type="checkbox"/>	Strongly agree
--------------------------	--------------------------	--------------------------	-----------------	--------------------------	-----------------------------------	--------------------------	--------------	--------------------------	-----------------------

Comments

9. "When students work either individually or in teams on well researched questions it almost goes without saying that they will want to engage in some specific desired action following their research, presentation and reflective practice...It is crucial that the inquiry learning process provides the opportunity for students to take an action step following their research, as this can have a considerable impact on their "community", in the widest sense of the word."

<input type="checkbox"/>	Strongly disagree	<input type="checkbox"/>	Disagree	<input type="checkbox"/>	Neither agree nor disagree	<input type="checkbox"/>	Agree	<input type="checkbox"/>	Strongly agree
--------------------------	--------------------------	--------------------------	-----------------	--------------------------	-----------------------------------	--------------------------	--------------	--------------------------	-----------------------

Comments

Inquiry Learning in an ICT-rich Environment

2. How would you define inquiry learning?

3. Teacher Use of ICT to Implement Inquiry-based Learning

Which ICTs have **you**, the teacher, used when implementing your last four inquiry-based units and for what purpose? **Do not include use by students.** Include software, hardware and use of internet. Rate each item from 0 = not useful - 4 = extremely useful for the purpose. Continue on the back if necessary.

<u>Stage of the inquiry process</u>	Which ICT's were used by you , the teacher, at this stage?	Rate 0 - 4	<u>Stage of the inquiry process</u>	Which ICT's were used by you , the teacher, at this stage?	Rate 0 - 4
Teacher planning			Model/demonstrate use of a worksheet, website etc.		
Brainstorm/Record prior knowledge of students			Display reminders, instructions steps to follow		
Motivate students at start of unit			Model sorting, sifting and analysing data		
Knowledge Bomb/Immersion in topic for students			Demonstrate/model synthesis/creation of product		
Display scenario/essential question/task for students			Demo/model presentation/communication of findings		
Brainstorm and/or list subsidiary questions with students			Demonstrate/model evaluation process/use of rubrics		
Modelling student planning/Shared class planning			Other: (give details)		
Model/demonstrate use of skills eg use of search engine, skills tutorial			Other: (give details)		

4. Student Use of ICT to Implement Inquiry-based Learning

Which ICTs have **your students** used when completing a typical inquiry-based unit and for what purpose? Include software, hardware and use of internet.

<u>Stage of the inquiry process</u>	Which ICT's were used by your students at this stage? Continue on the back if necessary.	0 - 4	<u>Stage of the inquiry process</u>	Which ICT's were used by your students at this stage? Continue on the back if necessary.	0 - 4
Brainstorm/Record prior knowledge			Sorting, sifting and analysing data		
Gain general background knowledge of topic eg immersion			Synthesising/creating product		

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Deciding on inquiry question/problem			Presentation/communication of findings		
Brainstorm subsidiary questions			Action at end as a result of inquiry.		
Developing research plan			Evaluation		
Accessing task/scenario and/or websites eg in a webquest			Other: (give details)		
Retrieving information			Other: (give details)		
Recording information retrieved			Other: (give details)		

6. Outcomes

Describe any actions/applications (eg. products/social actions/communications) from inquiry-based units of work your students have completed that involved ICT:

7. If you had a choice would you teach/facilitate inquiry learning in your classroom with or without ICT?

With Without

8. Have you taught/facilitated inquiry-based units of work in a classroom environment that was not ICT-rich?

Yes No

If the answer to question 8 was no then skip questions 9 and 10.

9. In comparison to teaching/facilitating inquiry-based units of work in a classroom environment that was not ICT-rich how do you find teaching/facilitating inquiry-based units of work in a classroom environment that is ICT-rich?

	Much easier		Easier		Neither easier nor harder		Agree		Strongly agree
--	--------------------	--	---------------	--	----------------------------------	--	--------------	--	-----------------------

Comments

10. Mark on the continuum where you think your current teaching style fits when teaching inquiry.

	Strongly student-centred		Student centred		Not dominantly teacher-centred or student-centred		Teacher-centred		Strongly teacher-centred
--	---------------------------------	--	------------------------	--	--	--	------------------------	--	---------------------------------

11. When comparing teaching/facilitating inquiry-based units of work in a classroom environment that was not ICT-rich, are there any differences in the way you teach and/or interact with students?

Yes No

If yes, do you consider those differences have been:

Minor Moderate Major

If the answer to question 11 was no go to question 12. If yes briefly list some of those differences:

12. Briefly describe any other aspects of inquiry-learning in an ICT-rich environment you would like to discuss in the interview:

Inquiry Learning in an ICT-rich Environment

Teacher Interview Questions

Describe what you felt was best about using ICT when implementing inquiry.

Describe what you liked least about using ICT when implementing inquiry.

What, if any, differences have you noted in the outcomes (i.e. products/actions/communication methods) of inquiry-based units of work your students have produced with ICT compared to without ICT?

Which aspects of ICT have you found the most valuable when implementing inquiry-based learning? Which are the ones you wouldn't be without if you were doing inquiry? In what ways were they valuable?

How did you teach inquiry prior to being in an ICT-rich environment?

What were some of the problems/difficulties/barriers (if any) that you faced when you taught inquiry prior to being in an ICT-rich environment?

Has being in an ICT-rich environment helped to overcome any of these problems/difficulties/barriers? If so, in what ways?

What advantages, if any, does an IWB have over a normal whiteboard/blackboard when implementing inquiry?

What advantages, if any, does the internet have over other sources of information when implementing inquiry learning?

What ratio of computers to students do you think is ideal in a classroom? Why?

What advantages, if any, does having a high ratio of computers to students have over having a very low ratio or no computers when implementing inquiry?

Do you prefer laptop or desktop computers (for student use)? Why?

If there has been a change in the way you teach inquiry since being in an ICT-rich environment what do you think are the reasons for that change?

Has using ICT made any difference to the way your students' work is viewed by others? If so, in what ways?

Is there anything else you wish to share with me on this topic?

Appendix Three: Student Questionnaires

Sample questions:

Student Questionnaire

A. Think about how helpful these ICT items were in completing your tasks so far. Tick or circle the box that best describes how helpful each item has been.

1. KnowledgeNET

Very helpful	Helpful	Neither helpful nor unhelpful	Unhelpful	Very unhelpful
--------------	---------	----------------------------------	-----------	----------------

In what ways was the KnowledgeNET helpful and/or unhelpful?

6. ICT Overall

Thinking about the use of all ICTs in your tasks so far, were they...

Very helpful	Helpful	Neither helpful nor unhelpful	Unhelpful	Very unhelpful
--------------	---------	----------------------------------	-----------	----------------

B. Think about whether ICT has made it easier or harder to complete your tasks so far.

2. The Internet

Much harder	Harder	Neither easier nor harder	Easier	Much easier
-------------	--------	------------------------------	--------	-------------

In what ways did the Internet make the task easier or harder?

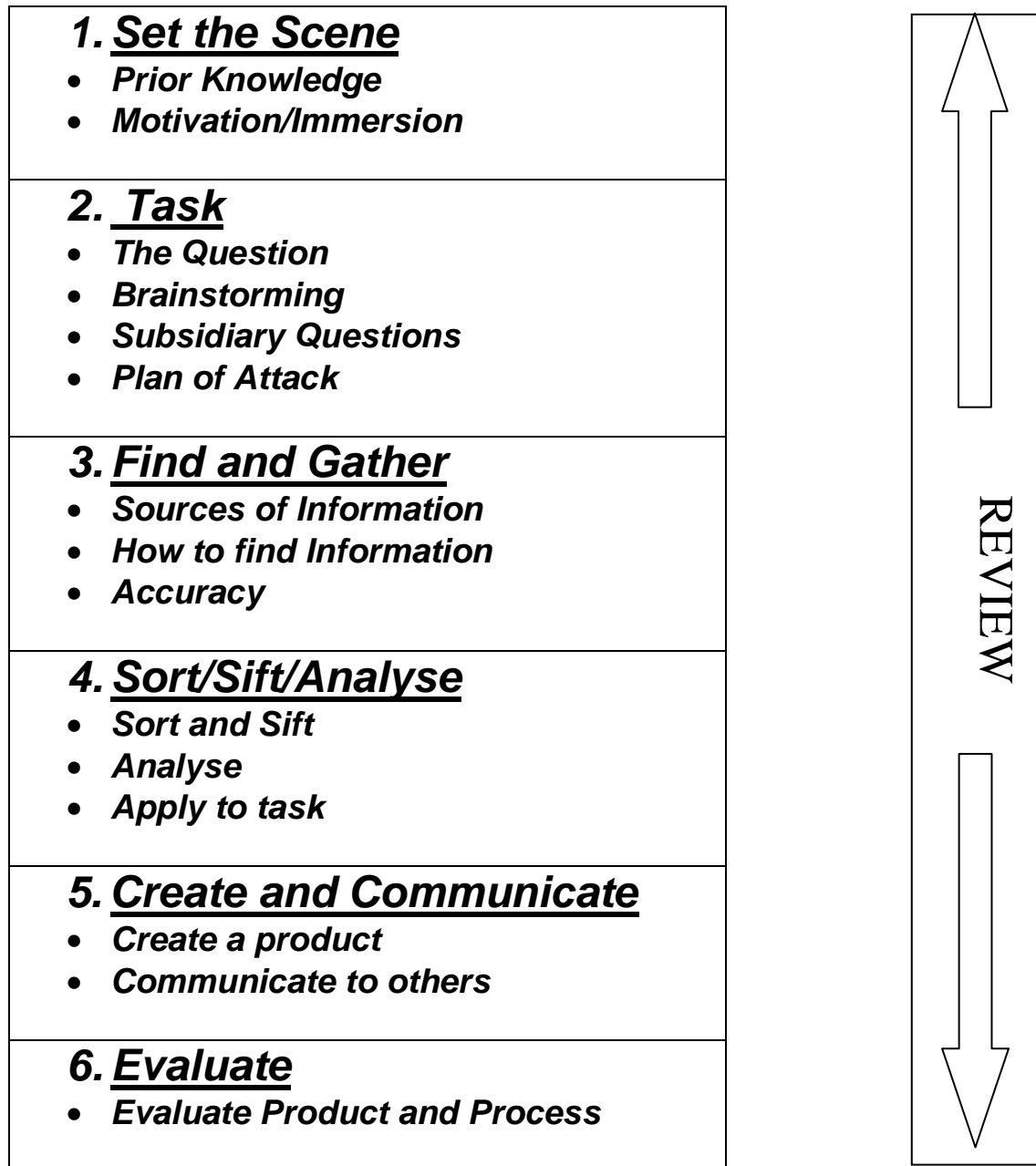
D. Without ICT

If you had no ICTs to use would completing the tasks so far have been ...

Much harder	Harder	Neither easier nor harder	Easier	Much easier
-------------	--------	------------------------------	--------	-------------

Why would it have been easier or harder?

Appendix Four: The Opoutere Learning Journey

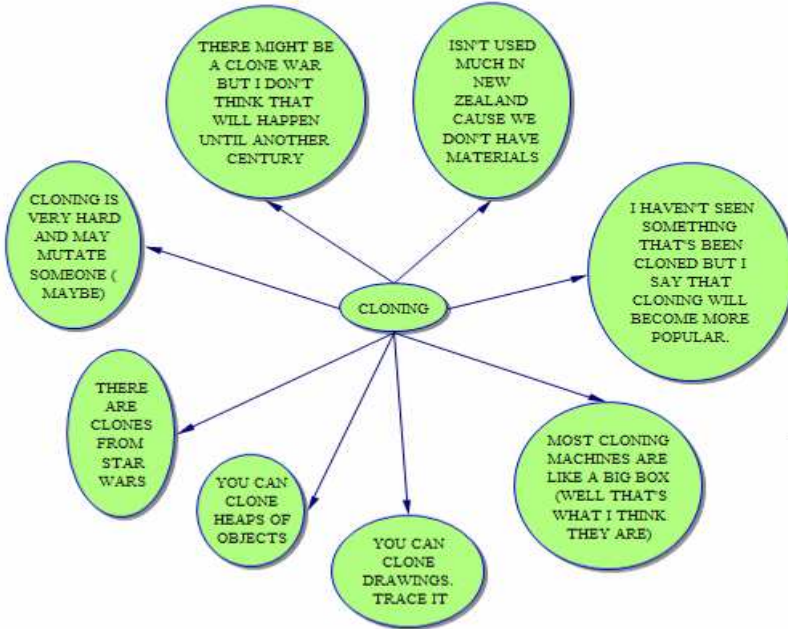


Appendix Five: Pre-test mind maps

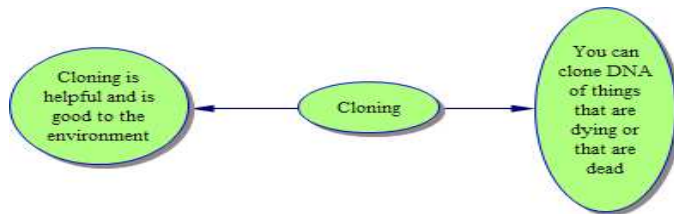
(Created using Inspiration™)

Group One: Cloning

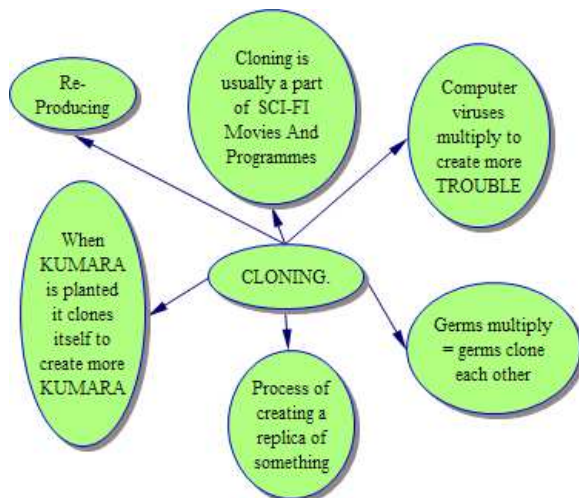
Dave - Prior knowledge on cloning



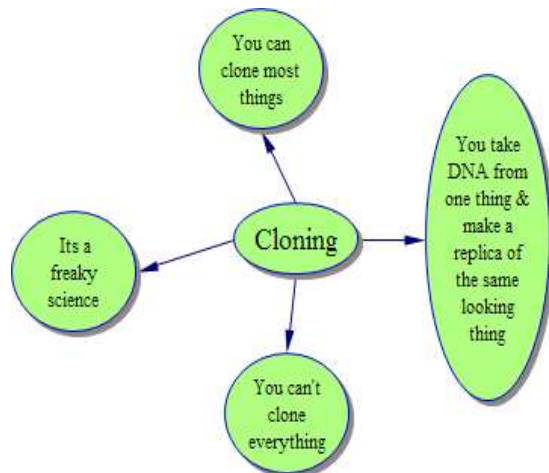
Jack - Prior knowledge on cloning



Yoko - Prior knowledge on Cloning

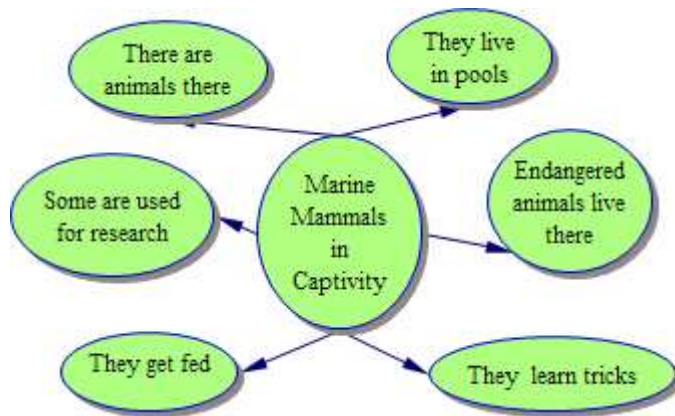


Jess – Prior Knowledge on Cloning

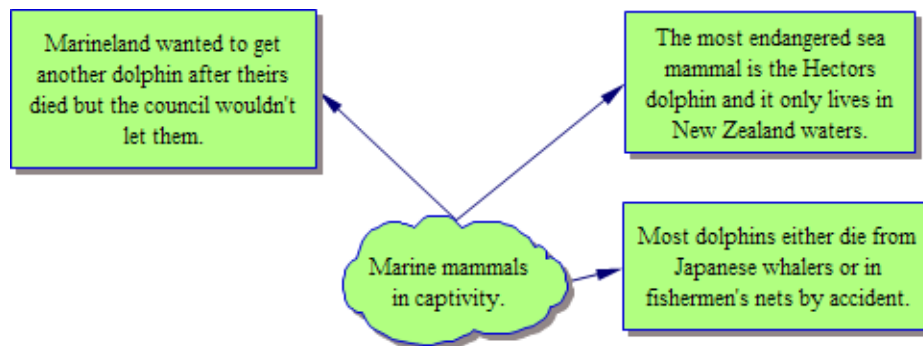


Group Two: Marine Mammals in Captivity

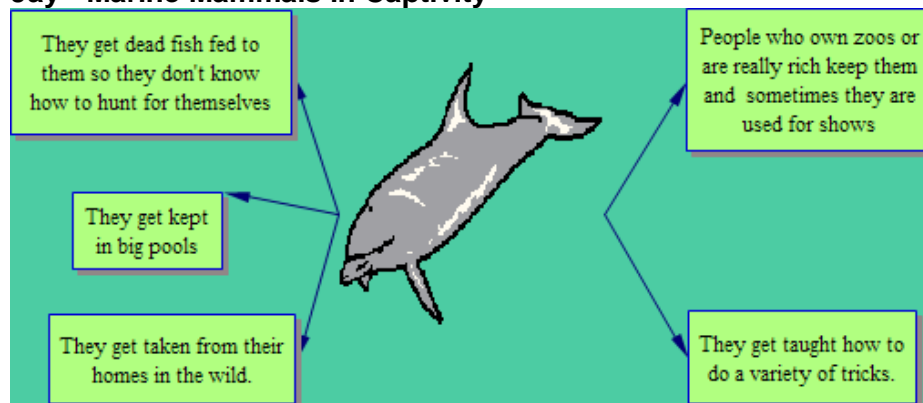
Leopold - Marine Mammals in Captivity



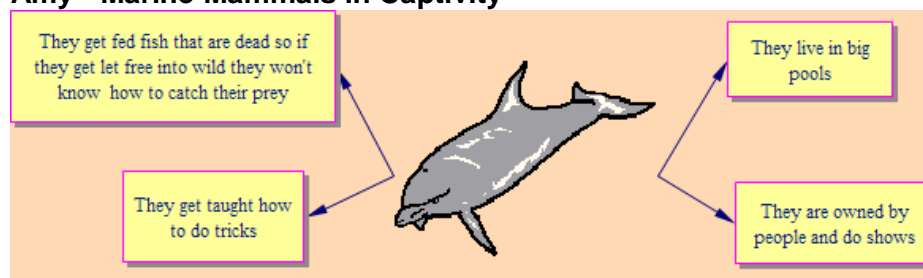
Bob - Marine Mammals in Captivity



Jay - Marine Mammals in Captivity



Amy - Marine Mammals in Captivity



Appendix Six: Final E-mails

Napier City Council

Dear Sir or Madam

We are two students from Opoutere School. We are writing to you because we think that you should allow Marineland to get a new dolphin provided they get bigger pools and they feed the dolphins live fish. They could earn the money by having fundraisers. We think that you should only let Marineland get a captive-bred dolphin, not one they capture from the wild.

Here are some more reasons that we have researched about why we think Marineland should be allowed to get a new dolphin: Firstly the dolphins in captivity can be used for breeding which we think is a good idea because it will prevent the different species of dolphins from becoming endangered or even extinct. It will also stop the marine park owners from having to buy new ones or catching new ones.

Secondly the people in Marineland can also teach the dolphins to do tricks and perform (which most ones already do) this will give Marineland money to feed the dolphins. Marineland also entertains the audience watching. Thirdly the dolphins in Marineland will be very safe and they will not get hunted or killed. When they are in captivity scientists will be able to research the dolphins, and find out new things about them. Then they will know they are giving them the right amount of food and exercise and they might be able to find out how to make them live longer.

Also, some dolphins may actually live longer in captivity. For example at Marineland the dolphins have lived for 36 years but in the wild they usually only live an average of 25 years.

What we want to happen is firstly, we would like Marineland to be allowed to buy another captive-bred dolphin and then try to breed them so that they don't have to buy or catch any more new ones. We also would like Marineland to try and make the pools bigger because we think it will make the dolphins happier and also that would give them more exercise which will make them healthier. Thirdly, we would like Marineland to give their dolphins the right food needed for them, like live fish not dead fish.

Thank you for your time, we really appreciate it.

Yours sincerely,

Amy and Bob

Letter to Hon. Chris Carter, Minister of Conservation

Thursday 29th June, 2006

Hon. Chris Carter
Parliament Buildings
Wellington

Dear Sir

We are two year eight students from Opoutere School and we're writing to you because we think that you should allow Marineland in Napier to get another dolphin in their park. We have come to the conclusion that Marineland should have a new dolphin because they provide entertainment to people and bring money into the Napier community.

Scientists can study the dolphins and find out new things about them. This may interest children who have already studied marine mammals and know a lot about them. Scientists can discover a wide range of new and exciting facts about dolphins that may not have yet been uncovered.

Firstly however, we think that the dolphins' pool should be enlarged so they can swim freely like when they are in the wild.

Secondly, if Marineland get some money, they would be able to establish new pools and breeding areas for all the marine mammals in the park.

Thirdly, we think that with these new pools and breeding areas, Marineland will be able to encourage more and more people to come to Marineland, therefore, making money for the park to establish more and bigger pools.

Also, the dolphin that is imported into Marineland shouldn't be from the wild, it should be from another marine zoo, because it is more humane.

In conclusion, we think that the size of the pools at Marineland are unacceptable and the dolphins cannot live peacefully because the pools are too small, so we would like to see some changes please. Once the changes have been made, Marineland should be allowed to then have a new dolphin imported into their park. Please take on board what we have said and please reply if you have the time.

Thank you for your time.

Yours Sincerely,

Leopold and Jay

Appendix Seven: Inquiry Rubric

Developed by the Galileo Educational Network

Group One Greyed areas indicate where students were working.

	Beginning	Developing	Accomplished
Authenticity	The scope of the inquiry is determined mainly by the curriculum.	The students have some influence in determining the scope of the inquiry.	The inquiry emanates from a question, problem or exploration that has meaning to the students.
	The inquiry task/s would not likely be tackled outside a school setting.	Other adults outside the school are intrigued by the inquiry task/s and can find ways to contribute to it.	An adult at work or in the community might actually tackle the question, problem or exploration posed by the inquiry task/s.
	The inquiry originates with and only meets program of studies expectations.	The inquiry originates with the program of studies but provides some opportunities to extend beyond curriculum expectations.	The inquiry originates with an issue, problem, question, exploration or topic that provides opportunities to create or produce something that contributes to the world's knowledge.
	The task/s contain/s few steps no separate roles are assigned.	The task/s contain/s some separate tasks or assigns some roles.	The task/s require/s a variety of roles or perspectives.
Academic Rigor	The inquiry provides for the acquisition of factual information.	The inquiry facilitates the acquisition and application of a broader understanding.	The inquiry leads students to build knowledge, not just acquire or apply it.
	The inquiry requires a clearly defined approach to externally generated criteria.	The student is offered a menu of approaches to inquiry to meet specific learning outcomes.	The inquiry challenges students to use methods of inquiry central to actual disciplines.
	The inquiry encourages students to memorize and repeat facts.	The inquiry encourages students to find relationships between and among concepts in more than one subject area.	The inquiry encourages students to develop habits of mind that encourage them to ask questions of <ul style="list-style-type: none"> • evidence (how do we know what we know?) • viewpoint (who is speaking?) • pattern and connection (what causes what?) • supposition (how might things have been different?) • why it matters (who cares?)
Learning in the World	The inquiry involves a teacher-structured problem framed directly from stated curriculum outcomes.	Students help develop or contribute to defining a relevant question, exploration, problem or issue for study that relates to the world outside the school.	The inquiry requires students to address a semi-structured question, exploration, issue or problem, relevant to curriculum outcomes, but grounded in the life and work beyond the school.
	All parameters of the inquiry (eg outcomes, due dates, & expectations) are established by the teacher prior to commencement of the inquiry.	Parameters & desired outcomes of the inquiry are set by the teacher. Milestones and organizational strategies are provided for student self monitoring.	The inquiry requires students to develop organizational and self management skills in order to complete the inquiry.
	The inquiry requires mainly individual effort, with little ongoing feed back on performance; the expectation for completion is handing it in.	Teacher presents the inquiry and students choose group members & topics from a menu of choices. The inquiry task could be completed independently, but this is not encouraged.	The inquiry leads students to acquire and use competencies expected in high performance work organizations (eg. Team work, problem solving, communications, decision making, project management).

Inquiry Learning in an ICT-rich Environment

	Beginning	Developing	Accomplished
Appropriate Use of Technology	The inquiry requires that all students use the same presentation mode.	The inquiry permits a variety of presentation modes.	The inquiry permits students to use a variety of technologies at every stage of the inquiry.
	Teacher decides which technologies will be used.	Students and teachers collaboratively decide which technologies will be used.	The inquiry requires students to determine which technologies are most appropriate to the task.
	Major focus is on developing skill and fluency with software applications.	The inquiry requires students to conduct research, share information, make decisions, solve problems, create meaning and communicate, mainly inside the classroom.	The inquiry requires students to conduct research, share information, make decisions, solve problems, create meaning and communicate with various audiences inside and outside the classroom.
	There is limited or no use of web-based resources.	Students use web based resources	The inquiry makes excellent use of the web's timeliness. Parents have on-going, on line access to the study as it develops.
	The inquiry requires use of word processing, simple presentation software and/or internet searching.	The inquiry permits the use of a wider variety of technology choices.	The inquiry requires sophisticated use of multimedia/hypermedia software, video, conferencing, simulation, databases or programming.
Active Exploration	The inquiry can be completed in limited amount of time, in a few areas, with teacher generated tasks	The inquiry requires increased time and variety of tasks spent on exploration.	The inquiry requires students to spend significant amounts of time doing field work, labs, interviews, studio work, construction, etc.
	The inquiry requires students to complete a series of teacher constructed activities using limited resources	The inquiry requires students to engage in a basic investigation using a variety of sources.	The inquiry requires students to engage in real (authentic) investigations using a variety of media, methods and sources.
	Students to communicate what they are learning with a presentation to teacher audience (i.e. handing in as an assignment)	The inquiry requires students to communicate what they are learning in a presentation to classroom audience	The inquiry requires students to communicate what they are learning with a variety of audiences through presentation or exhibition
Connecting with Experts	The inquiry requires students hear or read about relevant information only from the teacher, or resources provided by the teacher.	The inquiry involves speakers or interviews with experts outside the classroom.	The inquiry requires students to observe and interact with adults with relevant expertise and experience in a variety of situations.
	Students have limited, or no, access to experts	Guest speakers, other teachers, older students or other adults are available in a limited, perhaps one-shot way.	The inquiry requires students to work closely with and get to know at least one adult other than their teacher.
	Learning is strongly teacher directed	The inquiry requires some adult or student collaboration/input on design and implementation.	The inquiry requires adults to collaborate with one another and with students on the design and assessment of inquiry work.

Inquiry Learning in an ICT-rich Environment

	Beginning	Developing	Accomplished
Assessment	All assessment is done at the end of the study.	On-going assessment is conducted on an informal basis and evaluation is conducted at logical mid points in the process. Assessment feeds back into student and teacher next steps.	The inquiry provides opportunities for regular assessment of student work through a range of methods, including peer and self-evaluation. Assessment feeds back into student and teacher next steps.
	Assessment is mainly summative.	The inquiry provides opportunities for students to reflect on their learning using clear inquiry criteria established by the teacher. Teacher or parent helps students set goals, next steps or strategies.	The inquiry provides opportunities for students to reflect on their learning using clear inquiry criteria that they helped to set. Assessment allows students to set goals, next steps or strategies.
	Teacher is the only adult who assesses the work.	Teacher and self-assessment are used.	The inquiry provides opportunities for adults from outside the classroom and for peers to be involved in the assessment of the work.

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Group Two Greyed areas indicate where students were working.

	Beginning	Developing	Accomplished
Authenticity	The scope of the inquiry is determined mainly by the curriculum.	The students have some influence in determining the scope of the inquiry.	The inquiry emanates from a question, problem or exploration that has meaning to the students.
	The inquiry task/s would not likely be tackled outside a school setting.	Other adults outside the school are intrigued by the inquiry task/s and can find ways to contribute to it.	An adult at work or in the community might actually tackle the question, problem or exploration posed by the inquiry task/s.
	The inquiry originates with and only meets program of studies expectations.	The inquiry originates with the program of studies but provides some opportunities to extend beyond curriculum expectations.	The inquiry originates with an issue, problem, question, exploration or topic that provides opportunities to create or produce something that contributes to the world's knowledge.
	The task/s contain/s few steps no separate roles are assigned.	The task/s contain/s some separate tasks or assigns some roles.	The task/s require/s a variety of roles or perspectives.
Academic Rigor	The inquiry provides for the acquisition of factual information.	The inquiry facilitates the acquisition and application of a broader understanding.	The inquiry leads students to build knowledge, not just acquire or apply it.
	The inquiry requires a clearly defined approach to externally generated criteria.	The student is offered a menu of approaches to inquiry to meet specific learning outcomes.	The inquiry challenges students to use methods of inquiry central to actual disciplines.
	The inquiry encourages students to memorize and repeat facts.	The inquiry encourages students to find relationships between and among concepts in more than one subject area.	The inquiry encourages students to develop habits of mind that encourage them to ask questions of <ul style="list-style-type: none"> • evidence (how do we know what we know?) • viewpoint (who is speaking?) • pattern and connection (what causes what?) • supposition (how might things have been different?) • why it matters (who cares?)

Inquiry Learning in an ICT-rich Environment

Learning in the World	The inquiry involves a teacher-structured problem framed directly from stated curriculum outcomes.	Students help develop or contribute to defining a relevant question, exploration, problem or issue for study that relates to the world outside the school.	The inquiry requires students to address a semi-structured question, exploration, issue or problem, relevant to curriculum outcomes, but grounded in the life and work beyond the school.
	All parameters of the inquiry (eg outcomes, due dates, & expectations) are established by the teacher prior to commencement of the inquiry.	Parameters & desired outcomes of the inquiry are set by the teacher. Milestones and organizational strategies are provided for student self monitoring.	The inquiry requires students to develop organizational and self management skills in order to complete the inquiry.
	The inquiry requires mainly individual effort, with little ongoing feed back on performance; the expectation for completion is handing it in.	Teacher presents the inquiry and students choose group members & topics from a menu of choices. The inquiry task could be completed independently, but this is not encouraged.	The inquiry leads students to acquire and use competencies expected in high performance work organizations (eg. Team work, problem solving, communications, decision making, project management).

	Beginning	Developing	Accomplished
Appropriate Use of Technology	The inquiry requires that all students use the same presentation mode.	The inquiry permits a variety of presentation modes.	The inquiry permits students to use a variety of technologies at every stage of the inquiry.
	Teacher decides which technologies will be used.	Students and teachers collaboratively decide which technologies will be used.	The inquiry requires students to determine which technologies are most appropriate to the task.
	Major focus is on developing skill and fluency with software applications.	The inquiry requires students to conduct research, share information, make decisions, solve problems, create meaning and communicate, mainly inside the classroom.	The inquiry requires students to conduct research, share information, make decisions, solve problems, create meaning and communicate with various audiences inside and outside the classroom.
	There is limited or no use of web-based resources.	Students use web based resources	The inquiry makes excellent use of the web's timeliness. Parents have on-going, on line access to the study as it develops.
	The inquiry requires use of word processing, simple presentation software and/or internet searching.	The inquiry permits the use of a wider variety of technology choices.	The inquiry requires sophisticated use of multimedia/hypermedia software, video, conferencing, simulation, databases or programming.
Active Exploration	The inquiry can be completed in limited amount of time, in a few areas, with teacher generated tasks	The inquiry requires increased time and variety of tasks spent on exploration	The inquiry requires students to spend significant amounts of time doing field work, labs, interviews, studio work, construction, etc.
	The inquiry requires students to complete a series of teacher constructed activities using limited resources	The inquiry requires students to engage in a basic investigation using a variety of sources.	The inquiry requires students to engage in real (authentic) investigations using a variety of media, methods and sources.
	Students to communicate what they are learning with a presentation to teacher audience (i.e. handing in as an assignment)	The inquiry requires students to communicate what they are learning in a presentation to classroom audience	The inquiry requires students to communicate what they are learning with a variety of audiences through presentation or exhibition.

Inquiry Learning in an ICT-rich Environment

Connecting with Experts	The inquiry requires students hear or read about relevant information only from the teacher, or resources provided by the teacher.	The inquiry involves speakers or interviews with experts outside the classroom.	The inquiry requires students to observe and interact with adults with relevant expertise and experience in a variety of situations.
	Students have limited, or no, access to experts	Guest speakers, other teachers, older students or other adults are available in a limited, perhaps one-shot way.	The inquiry requires students to work closely with and get to know at least one adult other than their teacher.
	Learning is strongly teacher directed	The inquiry requires some adult or student collaboration/input on design and implementation.	The inquiry requires adults to collaborate with one another and with students on the design and assessment of inquiry work.

	Beginning	Developing	Accomplished
Assessment	All assessment is done at the end of the study.	On-going assessment is conducted on an informal basis and evaluation is conducted at logical mid points in the process. Assessment feeds back into student and teacher next steps.	The inquiry provides opportunities for regular assessment of student work through a range of methods, including peer and self-evaluation. Assessment feeds back into student and teacher next steps.
	Assessment is mainly summative.	The inquiry provides opportunities for students to reflect on their learning using clear inquiry criteria established by the teacher. Teacher or parent helps students set goals, next steps or strategies.	The inquiry provides opportunities for students to reflect on their learning using clear inquiry criteria that they helped to set. Assessment allows students to set goals, next steps or strategies.
	Teacher is the only adult who assesses the work.	Teacher and self-assessment are used.	The inquiry provides opportunities for adults from outside the classroom and for peers to be involved in the assessment of the work.

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Appendix Eight: Assessment Rubrics

Oral Presentation Rubric

Student Name: _____

CATEGORY	4	3	2	1	Weighting	Score
Speaks Clearly	Speaks clearly and distinctly all (100-95%) the time.	Speaks clearly and distinctly most (85-94%) of the time.	Speaks fairly clearly most (85-94%) of the time.	Often mumbles or can not be understood.	x2	
Volume	Volume is loud enough to be heard by all audience members throughout the presentation.	Volume is loud enough to be heard by all audience members at least 90% of the time.	Volume is loud enough to be heard by all audience members at least 80% of the time.	Volume often too soft to be heard by all audience members.	x2	
Enthusiasm	Facial expressions and body language generate a strong interest and enthusiasm about the topic in others.	Facial expressions and body language sometimes generate a strong interest and enthusiasm about the topic in others.	Facial expressions and body language are used to try to generate enthusiasm, but seem somewhat faked.	Very little use of facial expressions or body language. Did not generate much interest in topic being presented.	x1	
Pauses	Pauses were effectively used 2 or more times to improve meaning and/or dramatic impact.	Pauses were effectively used once to improve meaning and/or dramatic impact.	Pauses were intentionally used but were not effective in improving meaning or dramatic impact.	Pauses were not intentionally used.	x1	
Preparedness	Student is completely prepared and has obviously rehearsed.	Student seems pretty prepared but might have needed a couple more rehearsals.	The student is somewhat prepared, but it is clear that rehearsal was lacking.	Student does not seem at all prepared to present.	x1	
Content	Shows a full understanding of the topic.	Shows a good understanding of the topic.	Shows a good understanding of parts of the topic.	Does not seem to understand the topic very well.	x1	
Posture and Eye Contact	Stands up straight, looks relaxed and confident. Establishes eye contact with everyone in the room during the presentation.	Stands up straight and establishes eye contact with everyone in the room during the presentation.	Sometimes stands up straight and establishes eye contact.	Slouches and/or does not look at people during the presentation.	x1	
Expression	Expression was often used to keep audience's interest and convey emotions appropriately.	Expression was sometimes used to keep audience's interest and convey emotions appropriately.	Expression was rarely used to keep audience's interest and convey emotions appropriately.	Expression was not used to keep audience's interest and convey emotions appropriately.	x1	
Total Score:						/40

Powerpoint™ Presentation Rubric

Student Name(s): _____

CATEGORY	4	3	2	1	Weighting	Score
Content - Accuracy	All content throughout the presentation is accurate. There are no factual errors.	Most of the content is accurate but there is one piece of information that might be inaccurate.	The content is generally accurate, but one or two pieces of information are clearly flawed or inaccurate.	Content is typically confusing and/or contains more than one factual error.	x4	
Originality	Presentation shows considerable originality and inventiveness. The content and ideas are presented in a unique and interesting way.	Presentation shows some originality and inventiveness. The content and ideas are presented in an interesting way.	Presentation shows an attempt at originality and inventiveness on 1-2 slides.	Presentation is a rehash of other people's ideas and/or graphics and shows very little attempt at original thought.	x2	
Sequencing of Information	Information is organised in a clear, logical way. It is easy to anticipate the type of material that might be on the next slide.	Most information is organized in a clear, logical way. One slide or item of information seems out of place.	Some information is logically sequenced. An occasional slide or item of information seems out of place.	There is no clear plan for the organization of information.	x2	
Effectiveness	Project includes all material and detail needed to gain a comfortable understanding of the topic. It presents a highly effective argument. Opinions are all backed with facts and/or examples.	Project includes most material and detail needed to gain an understanding of the topic but is lacking one or two key elements. Some facts and/or examples are given to back up opinions. It presents an adequate argument.	Project is missing more than two key elements. Most opinions are not backed with facts or examples and there is little detail.	Project is lacking several key elements and has inaccuracies. Detail is lacking and there are few if any facts or examples to back up the opinion. The argument is not clearly stated.	x2	
Background	Background does not detract from text or other graphics. Choice of background is consistent from slide to slide and is appropriate for the topic.	Background does not detract from text or other graphics. Choice of background is consistent from slide to slide.	Background does not detract from text or other graphics.	Background makes it difficult to see text or competes with other graphics on the page.	x1	
Fonts & Formatting	Font formats (e.g., size, colour, bold, italic, font type) have been carefully planned to enhance readability and content.	Font formats have been carefully planned to enhance readability.	Font formatting has been carefully planned to complement the content. It may be a little hard to read.	Font formatting makes it very difficult to read the material.	x1	
Spelling and Grammar	Presentation has no misspellings or grammatical errors.	Presentation has 1-2 misspellings, but no grammatical errors.	Presentation has 1-2 grammatical errors but no misspellings.	Presentation has more than 2 grammatical and/or spelling errors.	x2	

Inquiry Learning in an ICT-rich Environment

Use of Images	All graphics are attractive (size and colours) and support the theme/content of the presentation. Original graphics or photos are used where possible.	A few graphics are not attractive but all support the theme/content of the presentation. Some original graphics or photos are used.	All graphics are attractive but a few do not seem to support the theme/content of the presentation. Most images are not original.	Several graphics are unattractive AND detract from the content of the presentation. Images are mostly not original.	x2	
Image Sources	All images are used legitimately. The illustrator(s) and/or photographer(s) are given credit somewhere in the presentation.	All images are used legitimately. Sources are documented in the presentation for all images.	Sources are documented in the presentation for all "borrowed" images but it is unclear whether permission has been obtained.	Some images are borrowed from sites that do not have copyright statements or do not state that non-commercial use is allowed, OR sources are not documented for all images.	x2	
Sounds and Animation	Careful planning has gone into sounds and animation. All sounds improve the content or "feel" of the presentation.	Some planning has gone into sounds and animation. Most enhance the content or "feel" of the presentation, but 1-2 seem to be added for no real reason. None detract from the overall presentation.	Sounds and/or animation that are chosen are appropriate for the topic, but some detract from the overall presentation.	Sounds and/or animation are not appropriate for the presentation and/or detract greatly from the presentation.	x1	
Cooperation	Group delegates tasks and shares responsibility effectively all of the time.	Group delegates tasks and shares responsibility effectively most of the time.	Group delegates tasks and shares responsibility effectively some of the time.	Group often is not effective in delegating tasks and/or sharing responsibility.	x1	
Total Score:						/80

Bibliography Rubric

CATEGORY	4	3	2	1	Weighting	Score
Sources	More than 6 different, reliable sources.	4 - 6 different, reliable sources.	2 - 3 different, reliable sources.	0 - 1 different, reliable sources.	x3	
Spelling	No errors in spelling.	1-2 errors in spelling.	3-4 errors in spelling.	More than 4 errors in spelling.	x2	
Capitalization & Punctuation	No errors in capitalization or punctuation.	1-2 errors in capitalization or punctuation.	3 - 4 errors in capitalization and/or punctuation.	More than 4 errors in capitalization and/or punctuation.	x1	
Format	All books have title, author and date published and all websites have a URL and title, author and date where known.	Over 75% of books and websites have all the correct information.	50 - 74% of books and websites have all the correct information.	Less than 50% of books and websites have all the correct information.	x2	
Currency	All books and websites contain up-to-date information and over 80% were published in the last 10 years.	Over 80% of books and websites contain up-to-date information and over 70% were published in the last 10 years.	Over 70% of books and websites contain up-to-date information and over 60% were published in the last 10 years.	Less than 70% of books and websites contain up-to-date information and less than 60% were published in the last 10 years.	X2	
Total Score:						/40